

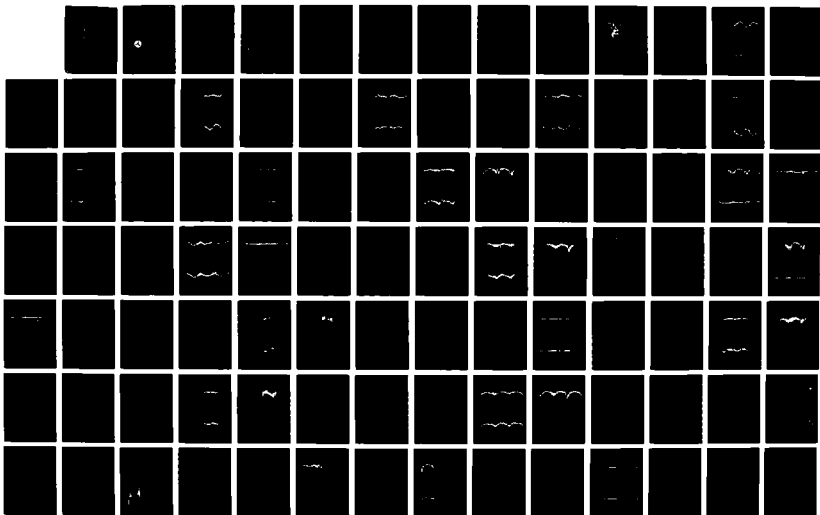
NO-A193 477 HARBOR MONITOR SYSTEM(U) COAST GUARD RESEARCH AND 1/3
DEVELOPMENT CENTER GROTON CT M M BLIZARD ET AL. DEC 86
CGR/DC-83/86 USCG-D-17-87

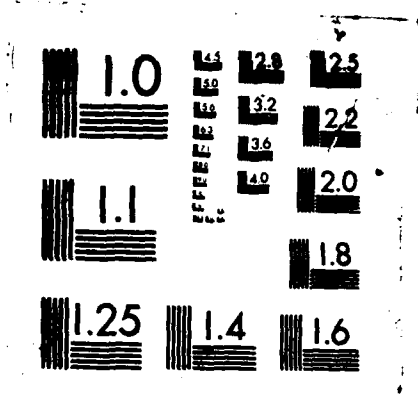
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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Report No. CG-D-17-87

**HARBOR MONITOR SYSTEM:
FINAL REPORT**

M. M. BLIZARD
D. C. SLAGLE
K. P. HORNBERG

U.S. COAST GUARD RESEARCH AND DEVELOPMENT CENTER
AVERY POINT, GROTON, CONNECTICUT 06340-6096

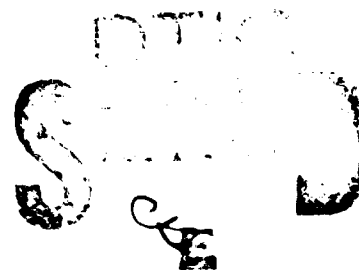


FINAL REPORT
DECEMBER 1986

This document is available to the U.S. public through the
National Technical Information Service, Springfield, Virginia 22161

Prepared for:

U.S. Department Of Transportation
United States Coast Guard
Office of Research and Development
Washington, DC 20593



Technical Report Documentation Page

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12. Sponsoring Agency Name and Address Department of Transportation U.S. Coast Guard Office of Research and Development Washington, D.C. 20593		14. Sponsoring Agency Code G-DST-1	
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16. Abstract <p>The Coast Guard's Office of Research and Development collected high quality Loran-C data for the Loran-C signal stability projects. This report presents three years of Loran-C Time Difference (TD) data collected at 59 locations around the United States and Canada. These locations cover every major Harbor Harbor Approach (HHA) area of the United States.</p> <p>For each location, information is broken down into three sections. The first section covers equipment type, accurate latitude and longitude, secondaries tracked and geometry. In the second section, we provided three year TD plots and average values for each secondary. The third section presents 95% probability error ellipses for each year and pair of secondaries.</p> <p>TD and error ellipse plots in this report clearly show that the year-to-year repeatability of Loran-C is excellent. Seasonal, weather and chain control procedures can also be seen within the data. Accurate Additional Secondary Phase Factors (ASF) can be calculated using the latitude, longitude, and TD values.</p>			
17. Key Words Loran-C Additional Secondary Factor (ASF) repeatability		18. Distribution Statement Document is available to the U S public through the National Technical Information Service, Springfield, Virginia 22161	
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	$\div 2.5$	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
AREA				
m ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
acres	acres	0.4	hectares	ha
MASS (WEIGHT)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
short tons (2000 lb)	short tons (2000 lb)	0.9	tonnes	t
VOLUME				
teaspoons	teaspoons	5	milliliters	ml
tablespoons	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (EXACT)				
°F	Fahrenheit temperature	$\frac{5}{9}$ (after subtracting 32)	Celsius temperature	°C

* 1" = 2.54 (exactly) for other exact conversions and more detailed tables.
See M&S Metric Publ. 288 Units of Weights and Measures Price \$2.75
SD Catalog No. C-13 10 288

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
AREA				
cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10,000 m ²)	2.5	acres	acres
MASS (WEIGHT)				
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	short tons
VOLUME				
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	0.125	cups	c
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³
TEMPERATURE (EXACT)				
°C	Celsius temperature	$\frac{9}{5}$ (then add 32)	Fahrenheit temperature	°F

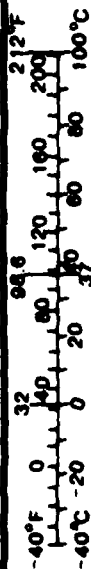


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THIS TAP	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Avail and/or	Special
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INTRODUCTION

The Coast Guard Research and Development Center has collected extensive Loran-C Time Difference (TD) data for the Loran-C Signal Stability Study projects. These projects investigate the potential of Loran-C to satisfy requirements for Harbor Harbor Approach (HHA) areas in the United States.

The purpose of this report is to present a large segment of the R&D Center's Loran-C database in a combined format. Sections of this data has been presented and analyzed in detail through a series of reports. These reports are available to the public through the National Technical Information Service (NTIS). Report titles and NTIS numbers are listed on page ix.

The two factors which affect the repeatability of Loran-C are chain geometry and signal stability. The chain geometry is dependent on transmitter locations and Geometric Dilution of Position (GDOP) can be calculated for any point. The stability of the Loran-C signal is affected by seasonal, diurnal, and weather induced TD variations along with chain control actions.

TD data presented in this report comes from two types of Loran-C receivers. Most of the data is from Internav LC-404(s) which is a four secondary, narrow band, survey grade receiver with a resolution of 10 nanoseconds. The second type is the Austron 5000 which is a wide band survey grade receiver used for chain control purposes. This receiver also has a 10 nanosecond resolution. Both receiver systems collect TD data four times a day for one hour. Collection times are, 0400 - 0500, 1000 - 1100, 1600 - 1700, and 2200 - 2300 Greenwich Mean Time. West coast data collection periods are one hour earlier to allow calling the sites during reduced rate hours. During these sample periods, the computer collects TD data every 40 seconds. From the 89 or 90 samples each hour, the mean TD value along with maximum and minimum excursion from mean and standard deviation are stored. The average Signal to Noise Ratio (SNR) is stored for retrieval from the LC-404 equipment. The R & D Center computer calls each site twice a week at night for data collection. Data is sorted and checked for problems before storage in individual site files on a hard disk. Problems are also printed on paper for the operator to manually check during normal working hours and only if proven bad, are flagged and not used within this report. Although this data may be the most extensive available, there are gaps within the TD plots. Reasons for this are varied, and include the site not being installed, site equipment failure, telephone line problems, and/or transmitters being off air. With as many as 39 remote sites on line at a time, equipment failures and telephone line problems

frequently took several days to a week or more to correct. Since the goal of this data collection program was to obtain the maximum amount of high quality data at minimum cost, few if any sites had spare equipment or trained technicians on location.

Data presented within this report covers years 1983 to 1985. This period was the most active of the harbor monitor program and involves 59 geographic locations. Equipment at four of these locations collected data from two Loran-C chains simultaneously. These locations are presented twice as different Loran-C chains, for a total of 63 monitors. Information on each of the 63 monitors is presented in three sections. First is a site information page, next are three year TD plots for each secondary, the third section presents 95% elliptical error plots for each pair of secondaries.

The site information page includes type of equipment, data collection dates, chain, and average TD's. Antenna latitude and longitude are included, along with the type of positioning system used. All locations within the United States were either surveyed by the R&D Center using Global Positioning System (GPS), or are considered as confirmed locations from previous geodetic and transit surveys. The Magnavox TSET used for the GPS surveys is a two channel C/A code receiver. GPS data was collected during the primary pass for three to five hours using four Space Vehicles (SV) when possible. The GPS data was carefully analyzed before averaging for each location. We are confident that all GPS WGS-72 positions are within 30 meters and should be better than 15 meters. Secondary LOP bearings and gradients are also included for each location.

The TD plots in the second section clearly show that year-to-year repeatability of Loran-C is excellent. Seasonal changes which dominate the annual repeatability of Loran-C are evident. With the exception of summer, it is also apparent that weather fronts cause rapid changes in the TDs. This data confirms that Loran-C TD variations are much larger for northern locations as expected. Scaling in the Y axis was kept as consistent as possible, with clarity of presentation determining when changes were necessary.

The third section presents 95% probability elliptical error plots which incorporate both standard deviations and the correlation coefficient. Error ellipses are calculated for each year, or partial year that data was collected for each pair of secondaries. These plots clearly show that the positional repeatability of Loran-C is also excellent.

The following additional reports on Loran-C signal stability are available to the public through the National Technical Information Service (NTIS), Springfield, Virginia 22161.

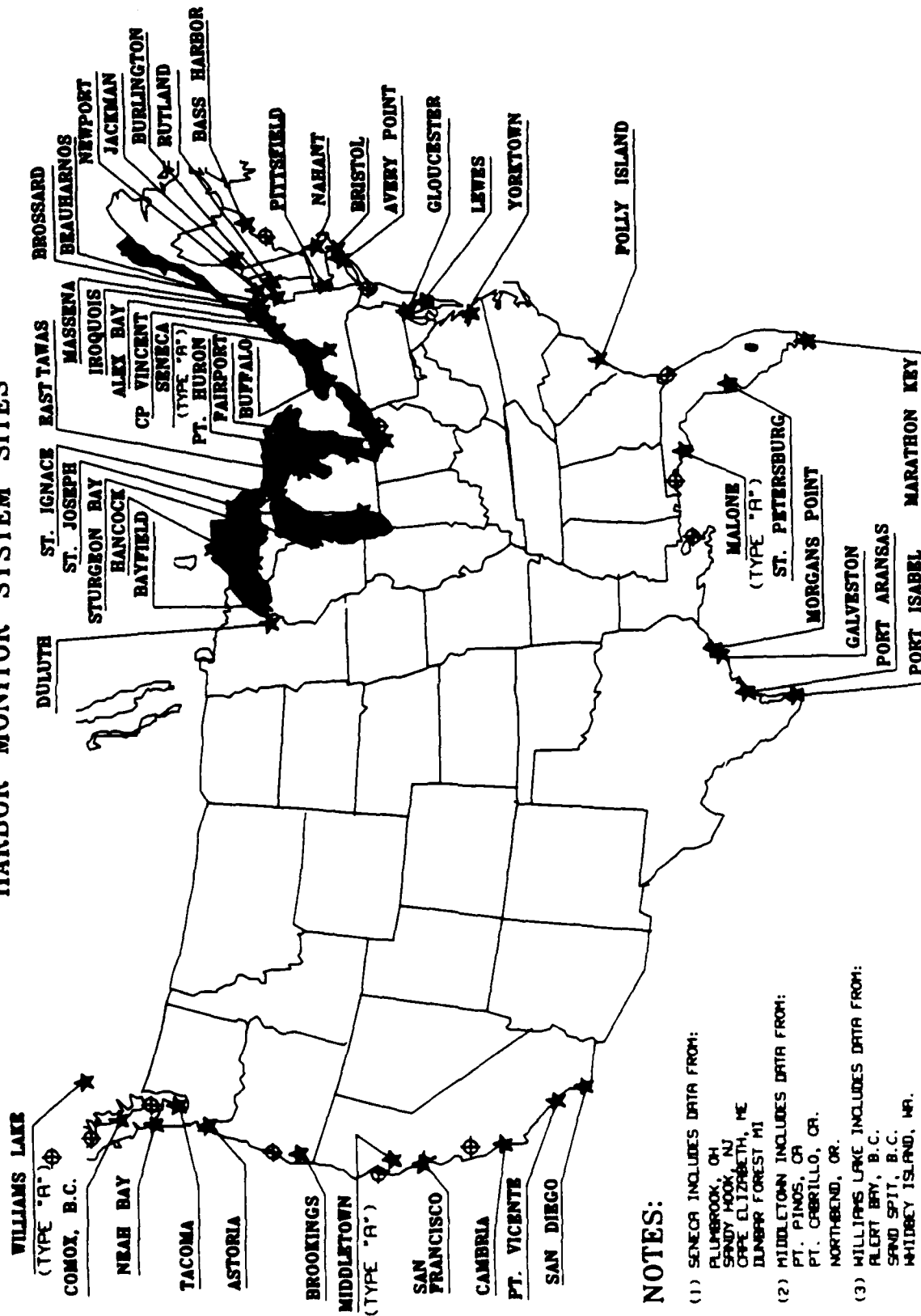
Loran-C Signal Stability Study: St. Lawrence Seaway
AD A126093

Loran-C Signal Stability Study: St. Marys River
AD A130609

Loran-C Signal Stability Study: Northeast and Southeast U. S.
AD A137628

Loran-C Signal Stability Study: West Coast
"Number to be assigned"

HARBOR MONITOR SYSTEM SITES



NOTES:

- (1) SENECA INCLUDES DATA FROM:
FLUMSBROOK, OH
SANDY HOOK, NJ
CAPE ELIZABETH, ME
DUNBAR FOREST MI
- (2) MIDDLETOWN INCLUDES DATA FROM:
PT. PINOS, CA
PT. CERRILLO, OR
NORTH-BEND, OR
- (3) WILLIAMS LAKE INCLUDES DATA FROM:
ALERT BAY, B.C.
SAND SPIT, B.C.
WHIDBEY ISLAND, WA.
- (4) MALONE INCLUDES DATA FROM:
DESTIN, FL. B.C.
NEW ORLEANS, LA.
MAYPORT, FL.

HMS SITE INFORMATION

ALERT BAY, BRITISH COLUMBIA, CANADA

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 06 December 1983 - Present

GRI: 5990 Canadian West Coast Chain

TDX: 14218.196 A2
TDY: 29940.892 A2
TDZ: 41195.580 A2

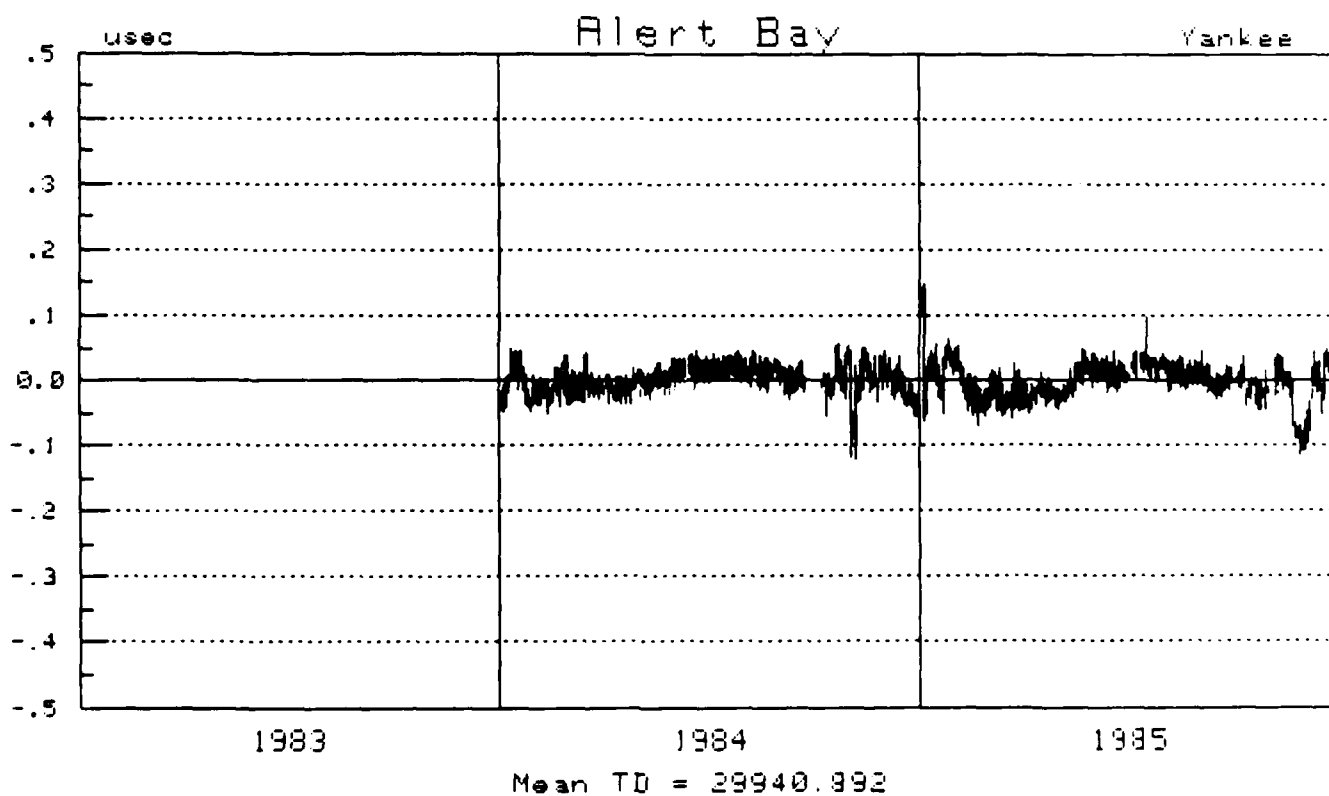
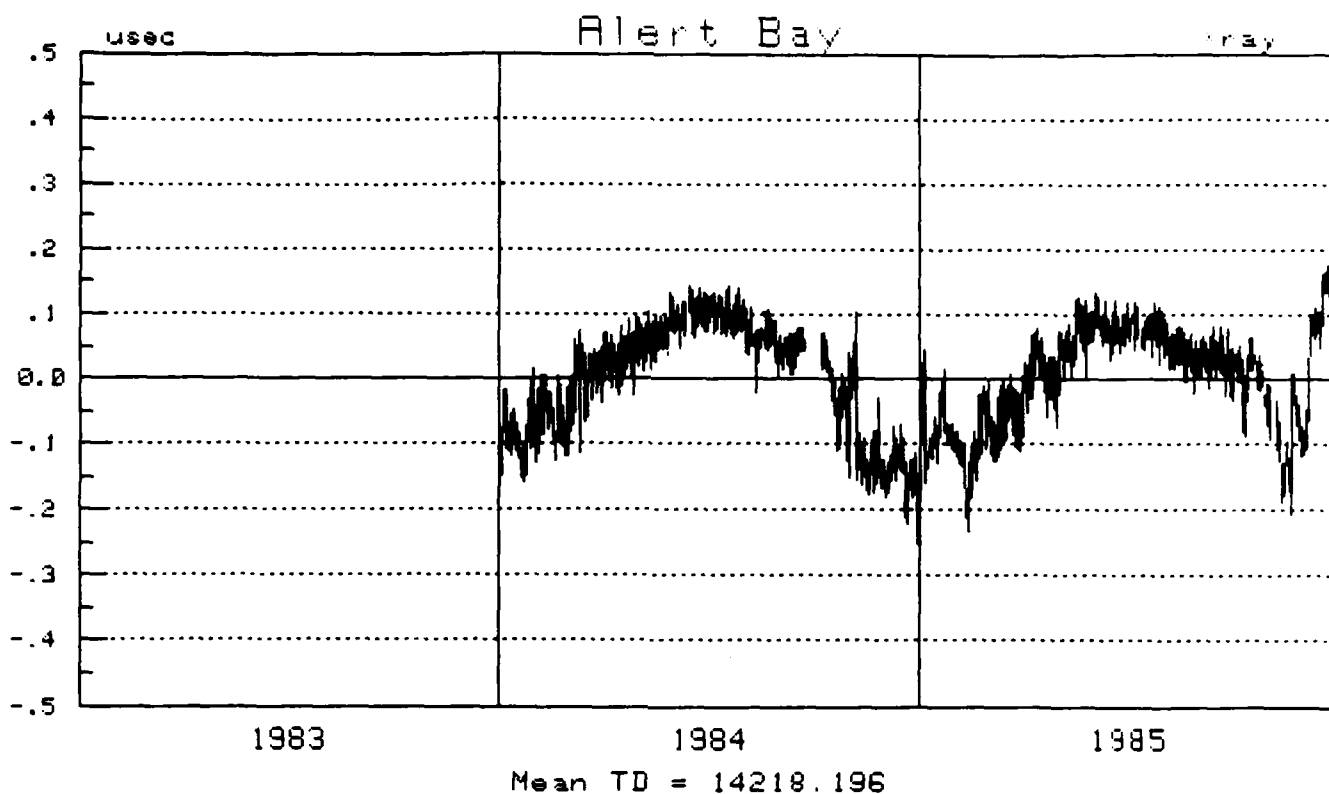
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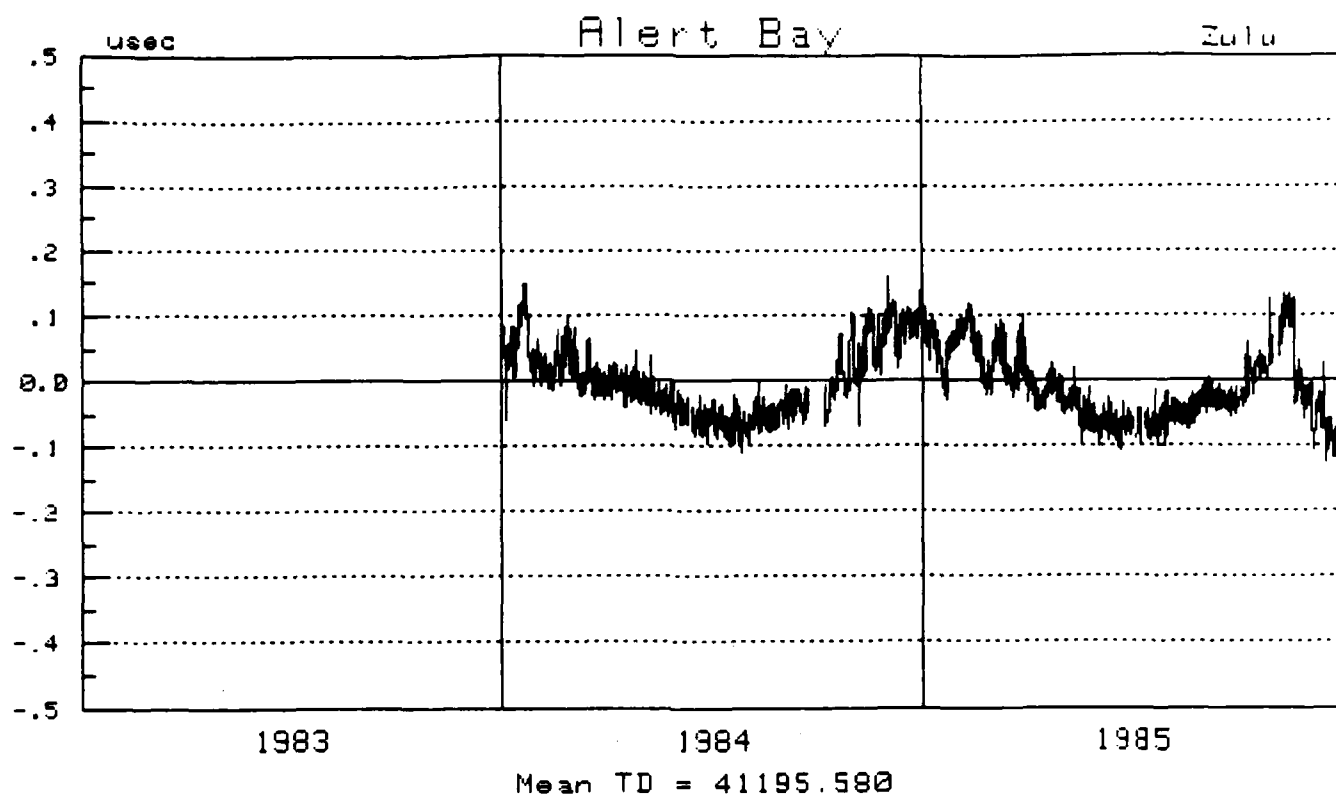
WGS 72
LAT : 50 34 56.0N
LON : 126 54 30.6W

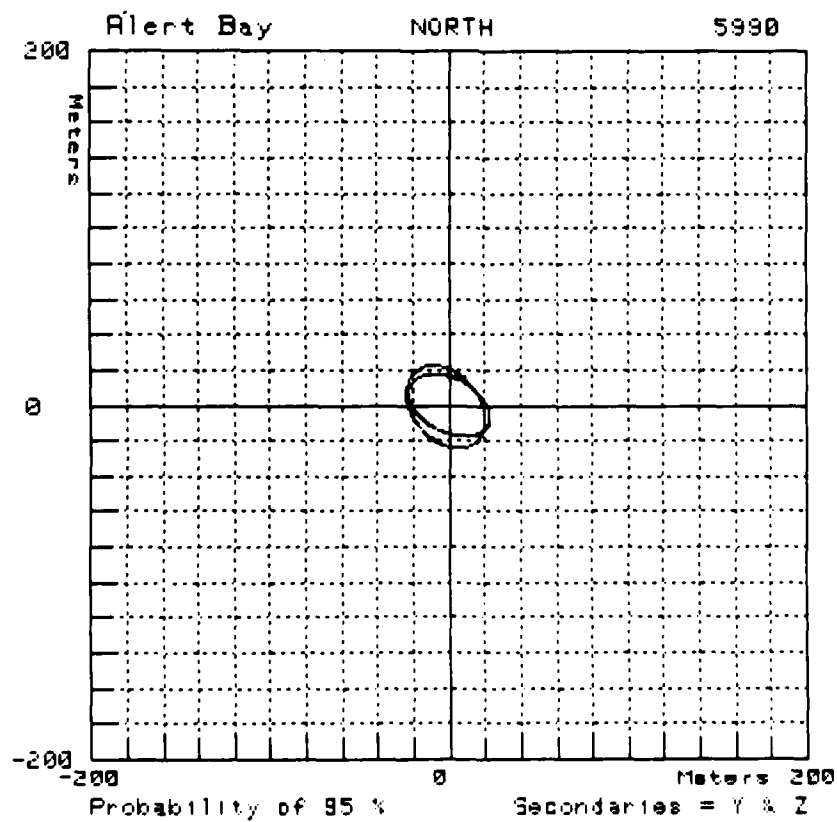
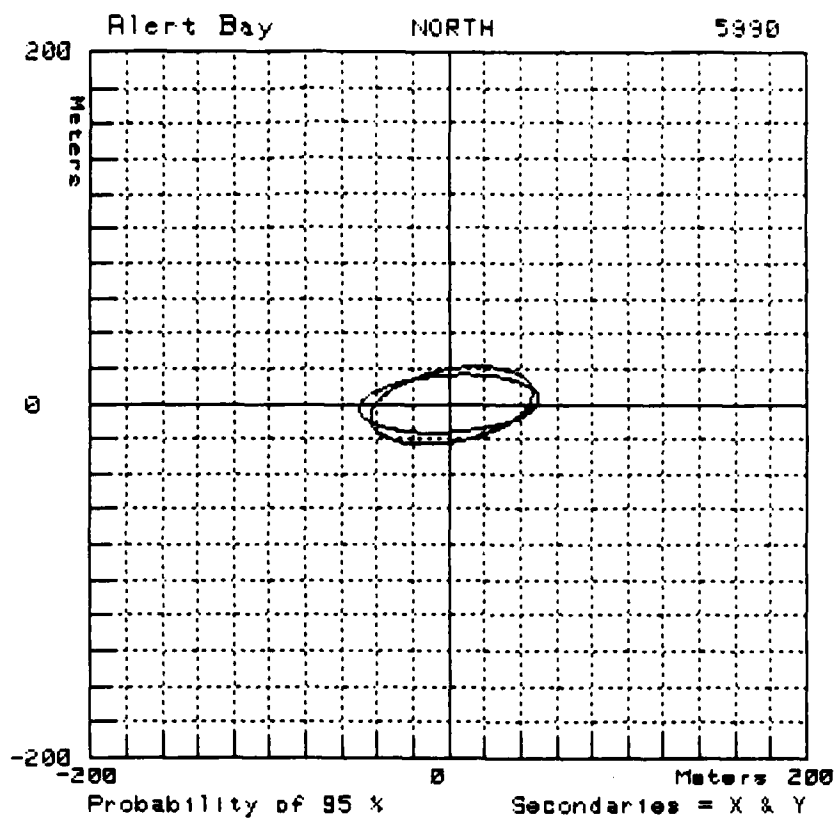
NAD 27
LAT : 50 34 57.14N
LON : 126 54 24.91W

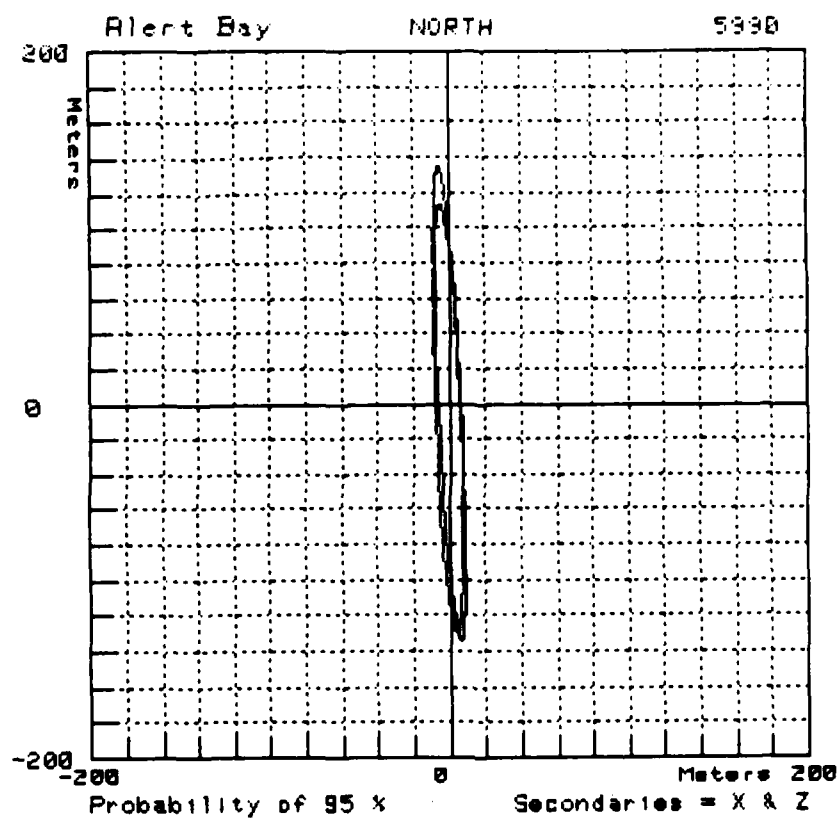
Positioning System
From G-NRN

X-LOP: 197.8 deg Gradients: 702 ft/usec
Y-LOP: 93.1 deg Gradients: 960 ft/usec
Z-LOP: 168.8 deg Gradients: 513 ft/usec









HMS SITE INFORMATION

ASTORIA, OREGON

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 16 February 1984 - 19 May 1985

GRI: 5990 Canadian West Coast Chain

TDY: 27837.862
TDZ: 41958.330

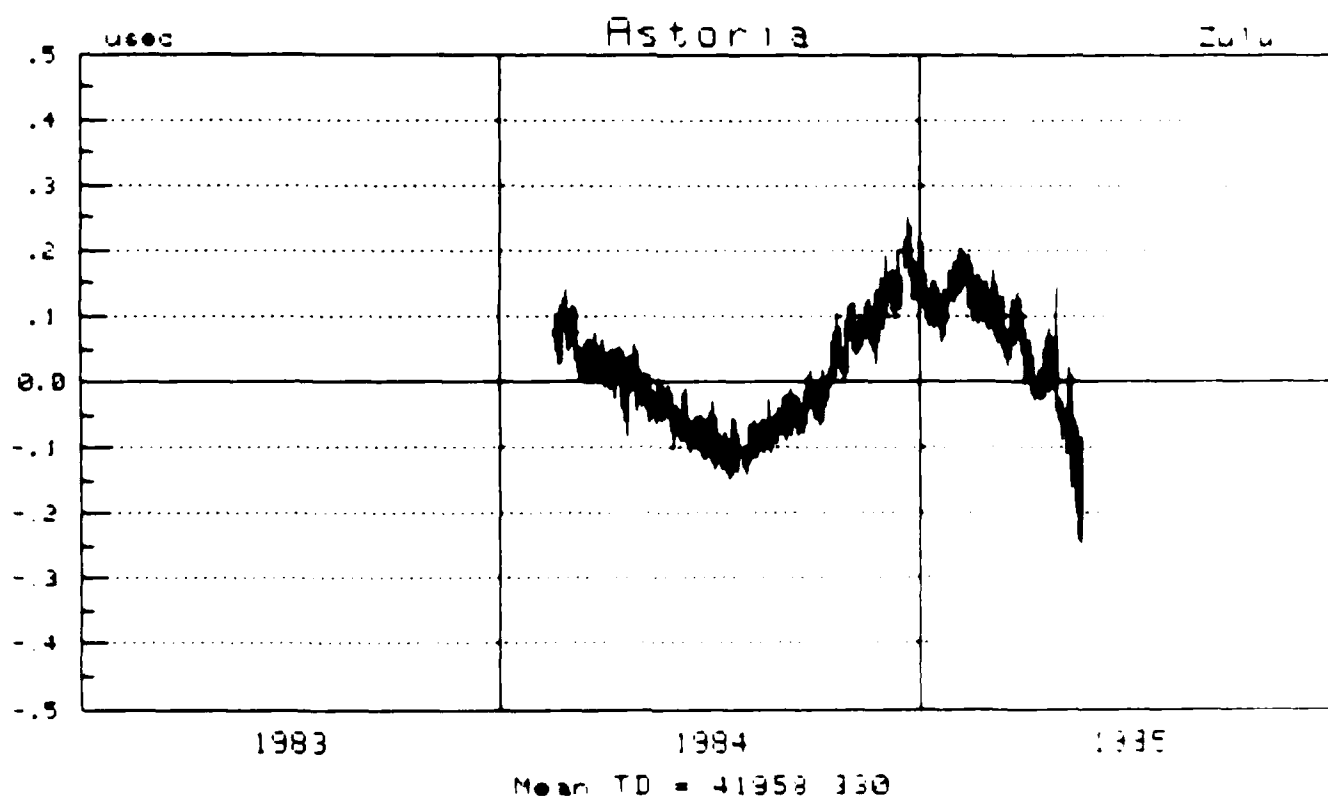
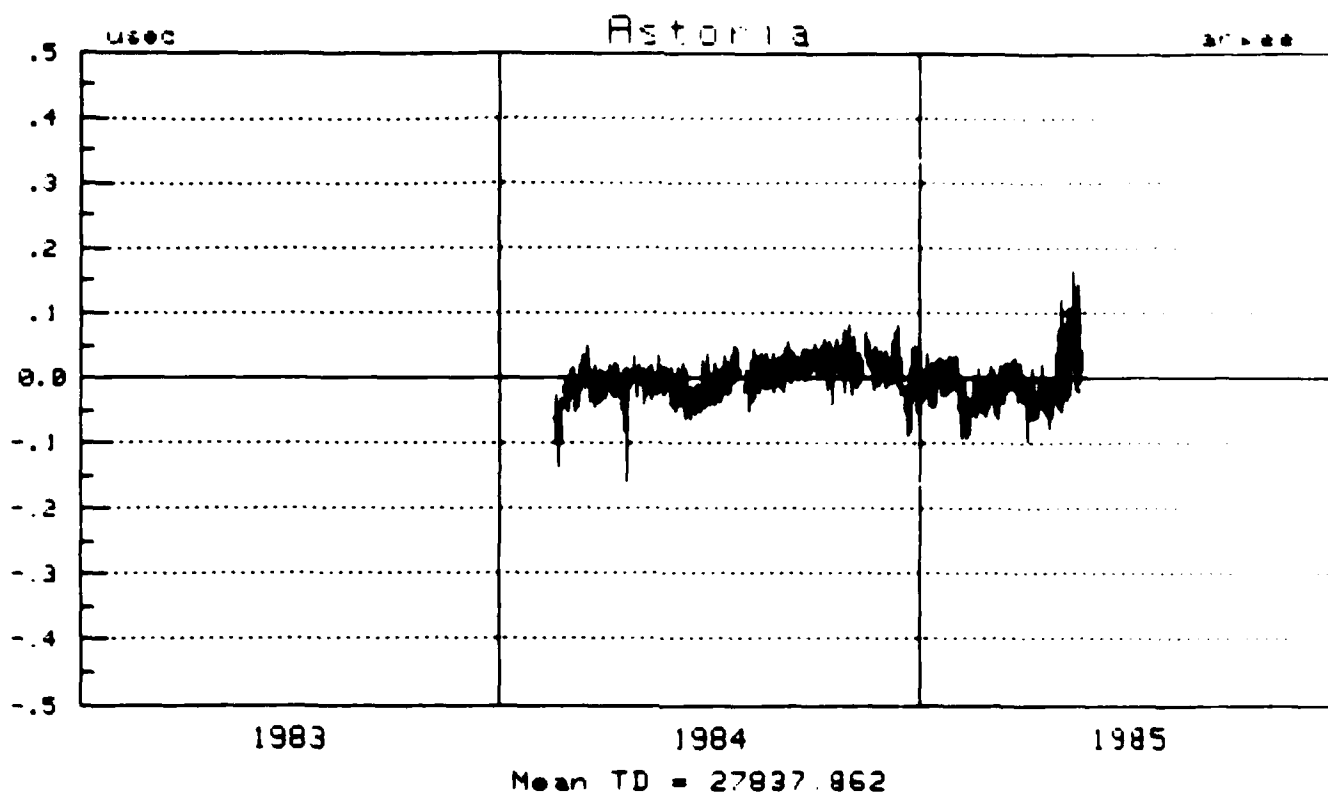
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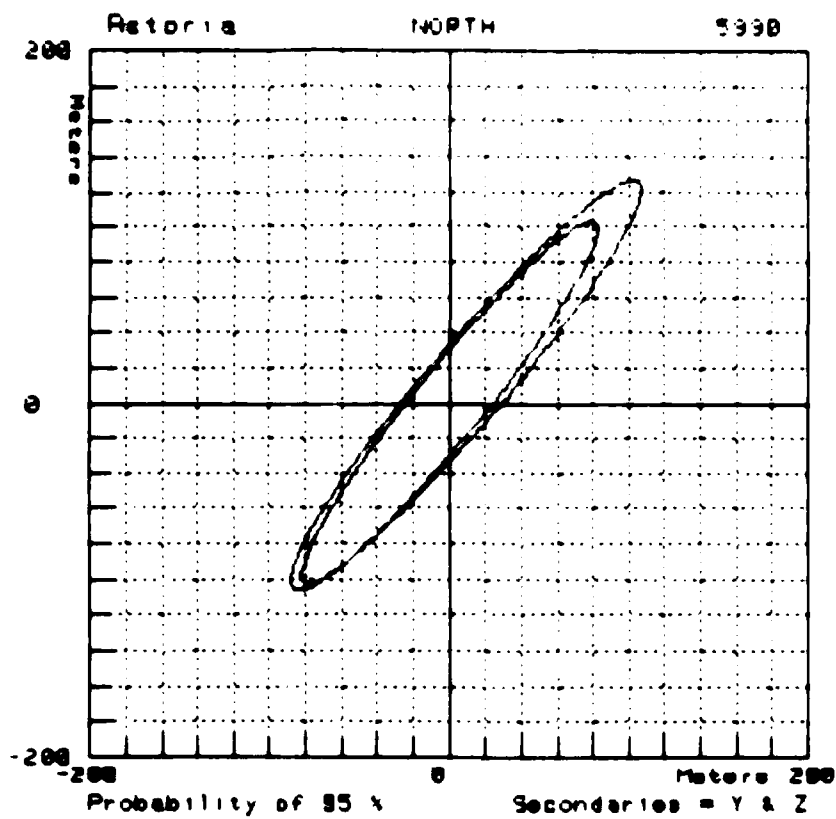
WGS 72
LAT : 46 12 28.72N
LON : 123 46 04.65W

NAD 27
LAT : 46 12 29.72N
LON : 123 45 59.73W

Positioning System
GPS

Y-LOP: 39.9 deg Gradients: 943 ft/usec
Z-LOP: 170.7 deg Gradients: 1602 ft/usec





HMS SITE INFORMATION

COMOX, BRITISH COLUMBIA, CANADA

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 10 September 1983 - Present

GRI: 5990 Canadian West Coast Chain

TDY: 29508.911
TDZ: 41910.596

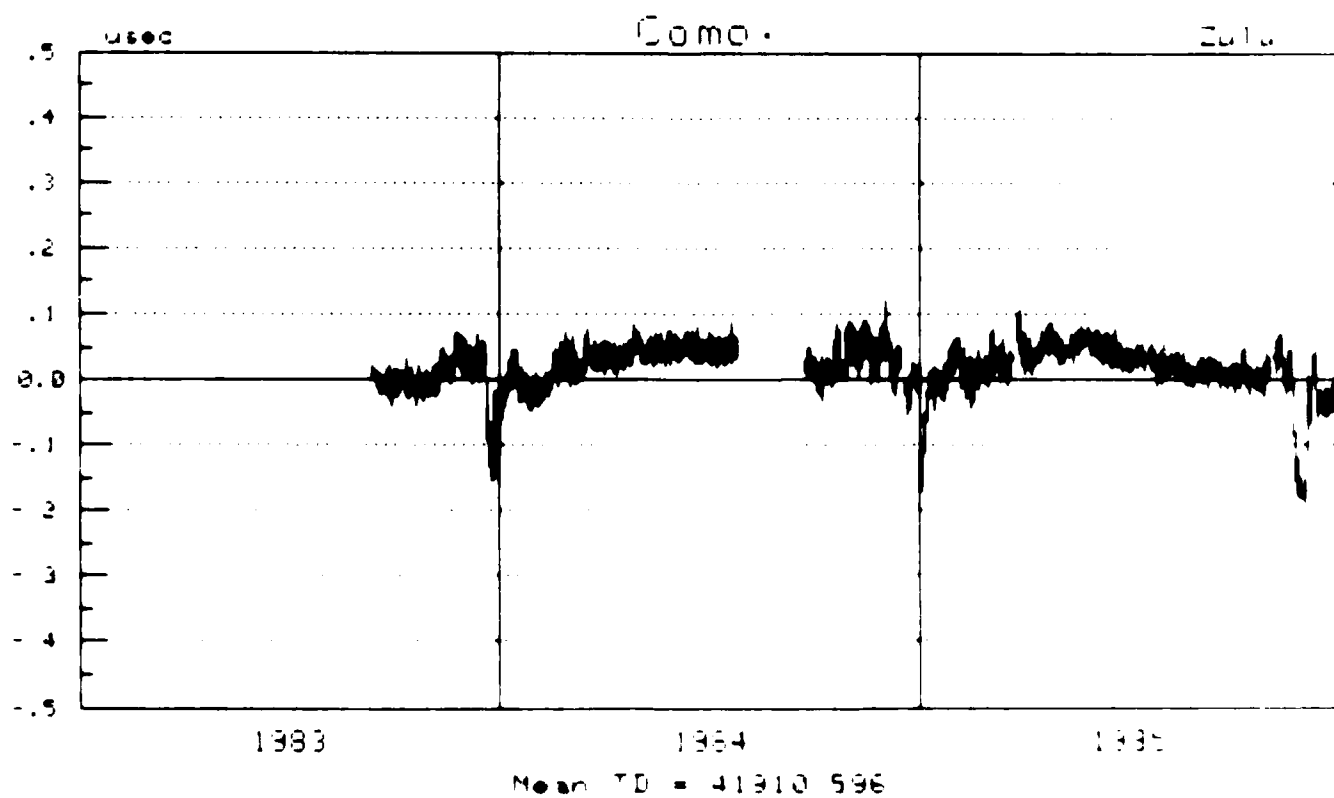
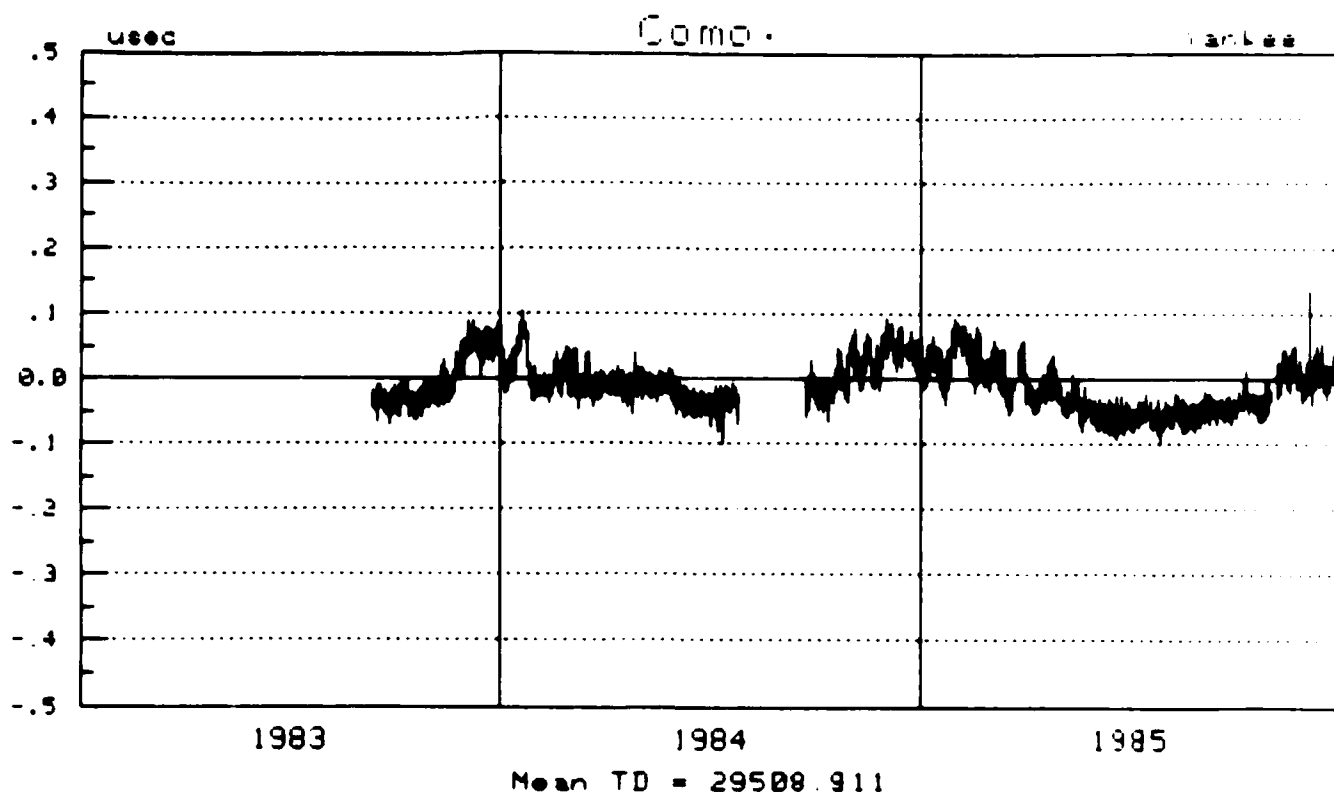
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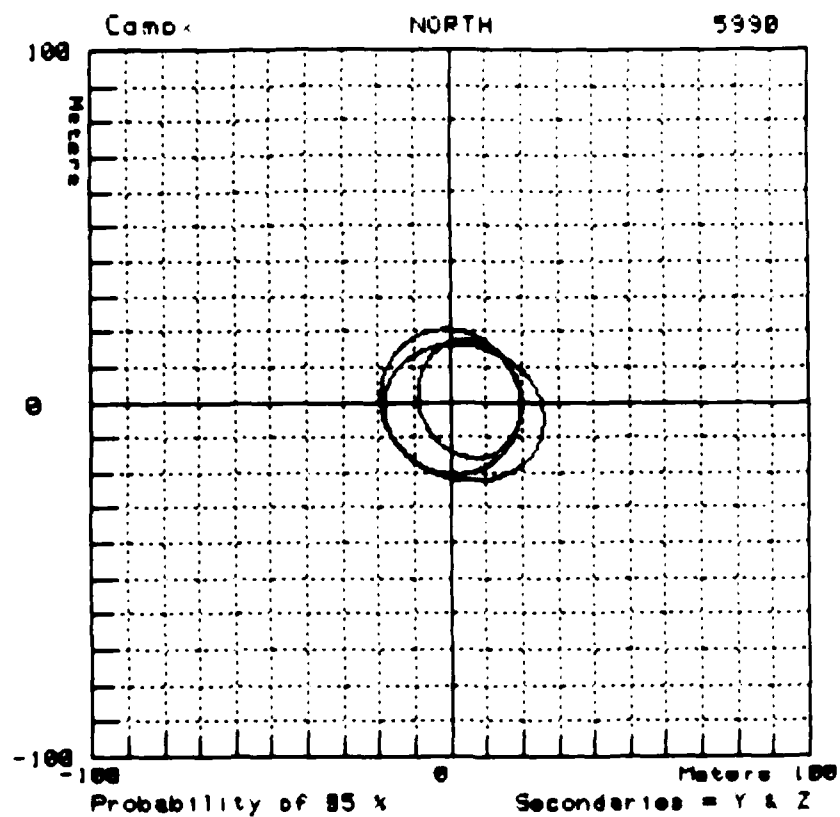
WGS 72
LAT : 49 42 34.94N
LON : 124 54 23.38W

NAD 27
LAT : 49 42 36 N
LON : 124 54 18 W

Positioning System
From Nautical Chart

Y-LOP: 80.1 deg Gradients: 688 ft/usec
Z-LOP: 347.5 deg Gradients: 673 ft/usec





HMS SITE INFORMATION

NEAH BAY, WASHINGTON

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 09 August 1982 - Present

GRI: 5990 Canadian West Coast Chain

TDY: 28798.839
TDZ: 41893.812

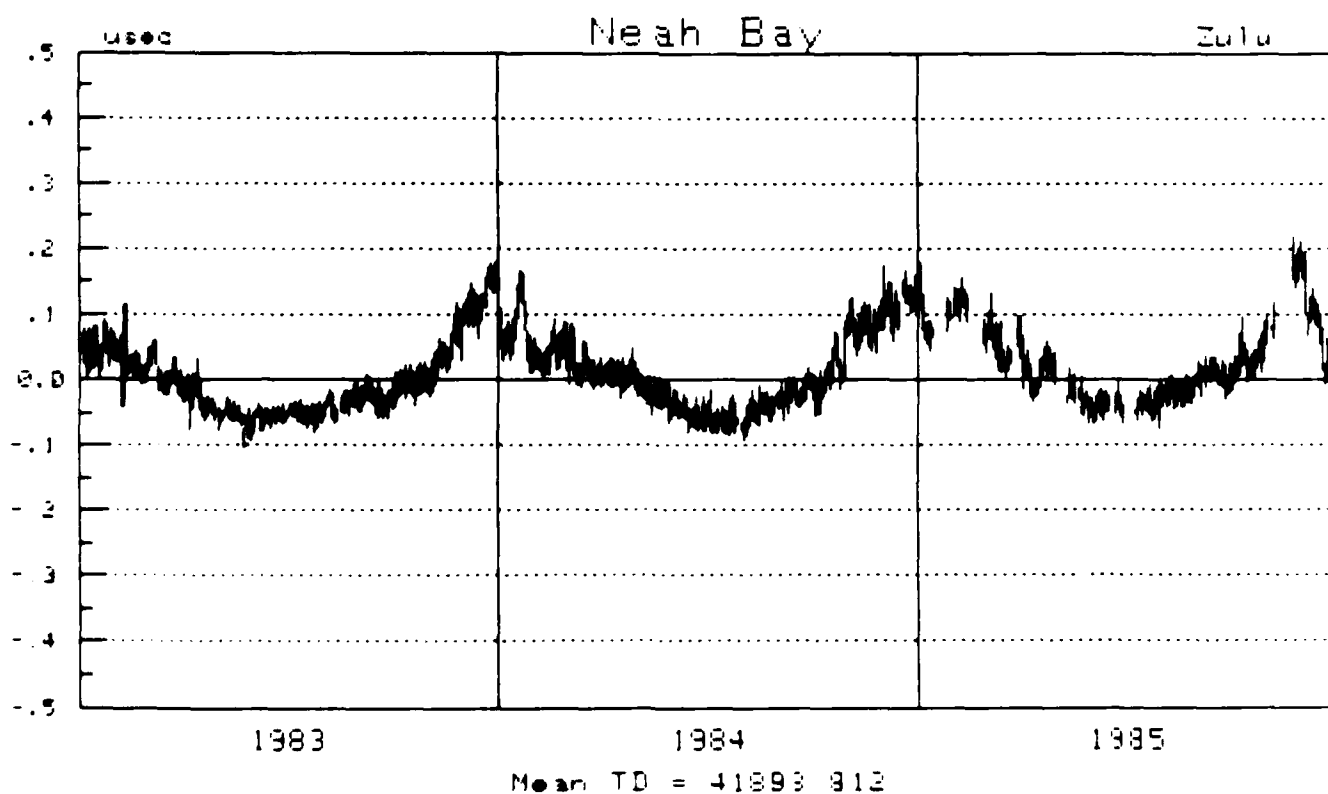
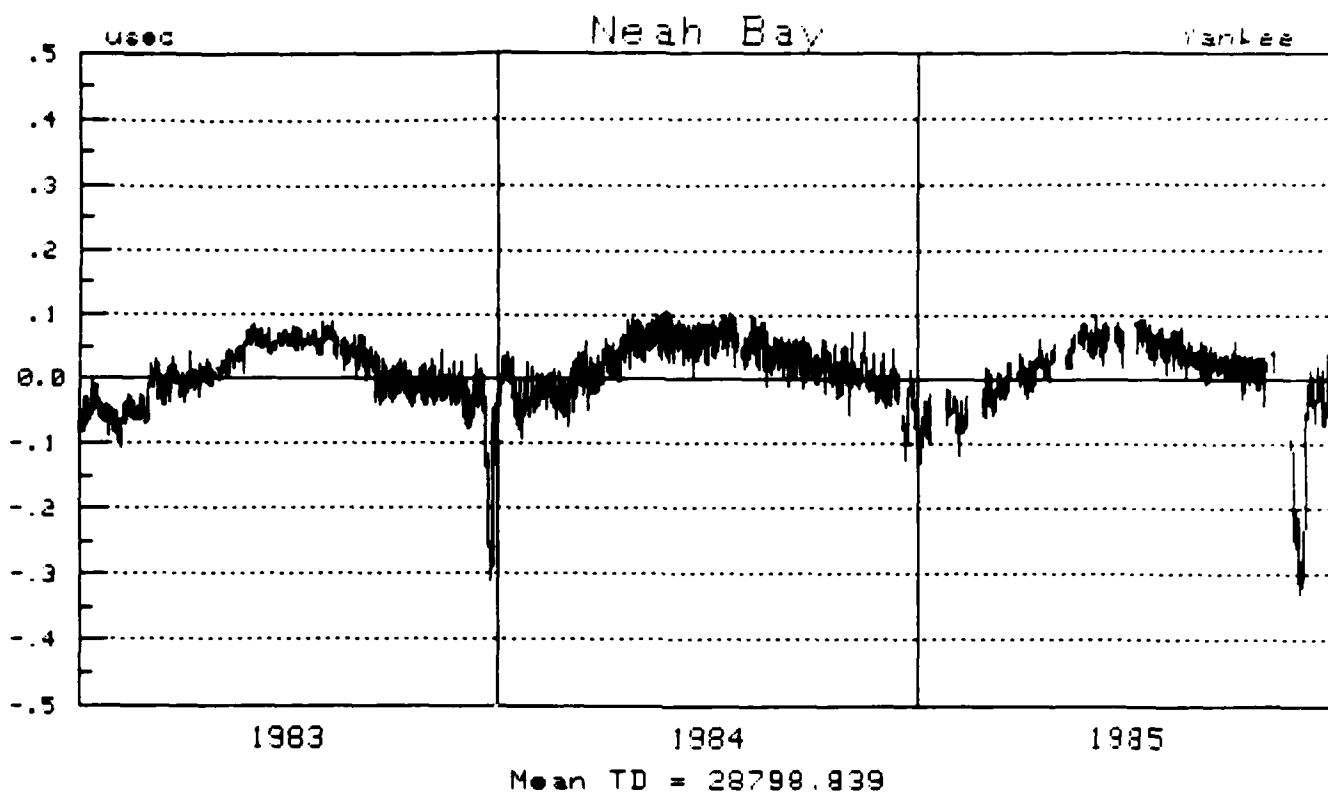
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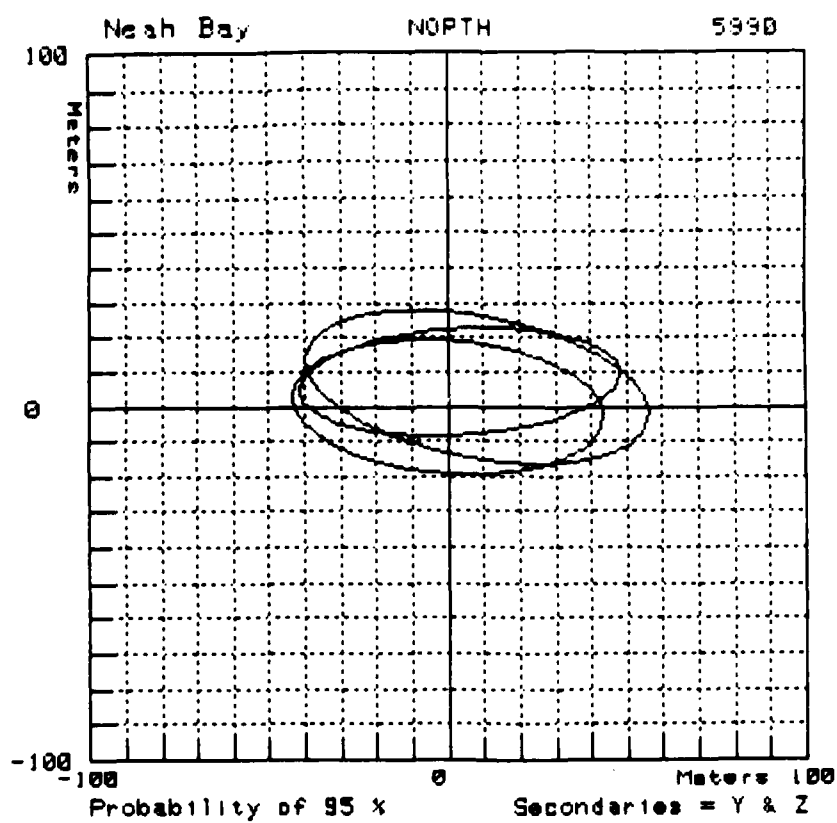
WGS 72
LAT : 48 22 10.53N
LON : 124 35 59.04W

NAD 27
LAT : 48 22 11.58N
LON : 124 35 53.83W

Positioning System
GPS

Y-LOP: 65.4 deg Gradients: 701 ft/usec
Z-LOP: 171.6 deg Gradients: 1005 ft/usec





HMS SITE INFORMATION

SANDSPIT, BRITISH COLUMBIA, CANADA

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 06 December 1983 - Present

GRI: 5990 Canadian West Coast Chain

TDX: 11974.421 A1

TDZ: 41495.535

Receiving Antenna Location:

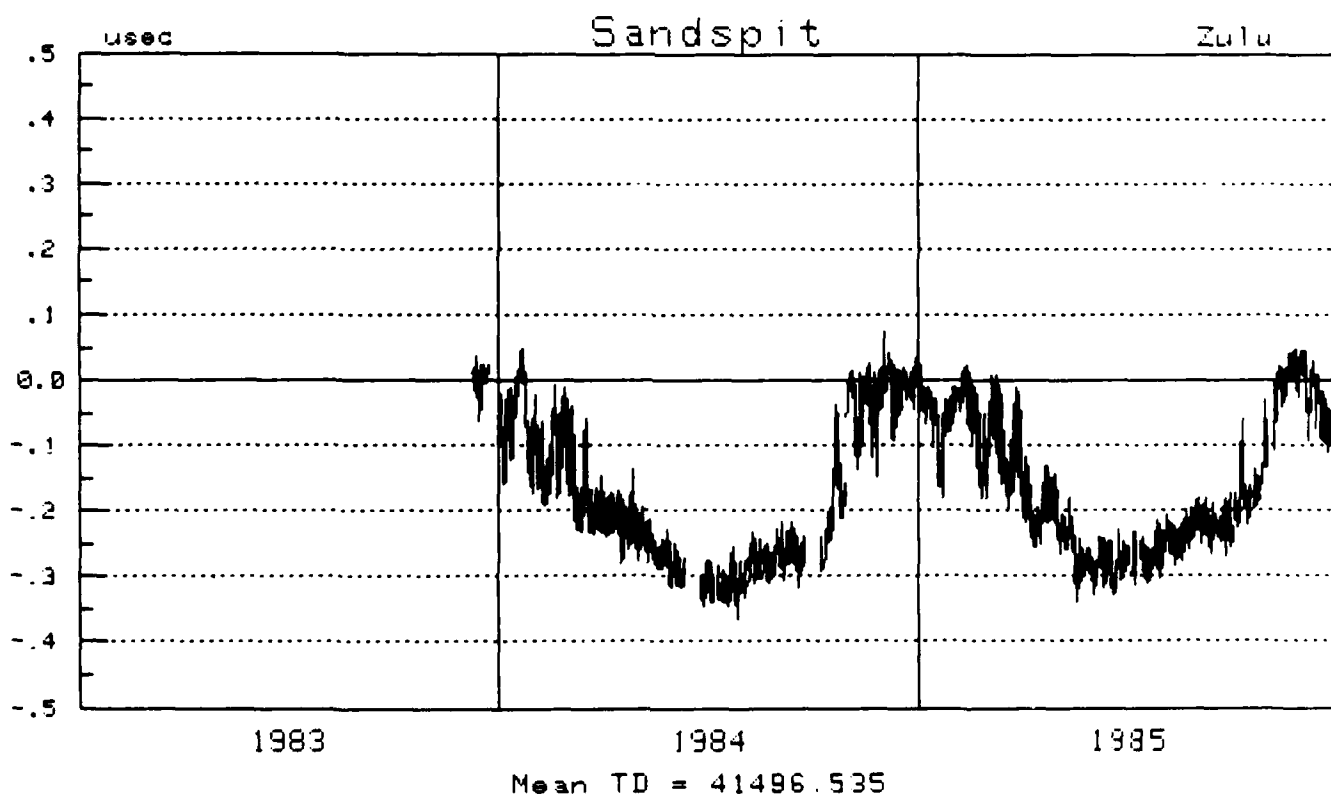
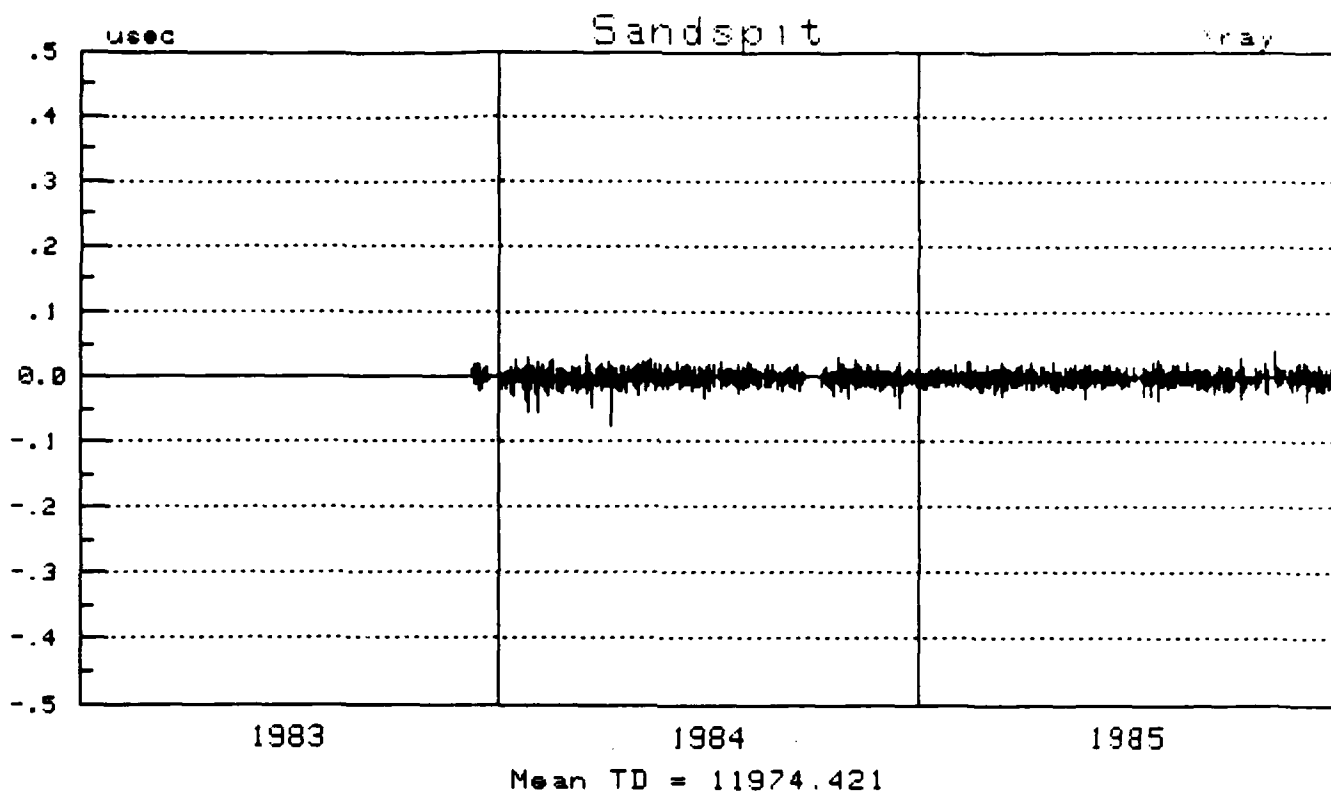
WGS 72
LAT : 55 14 0 N
LON : 131 48 50 W

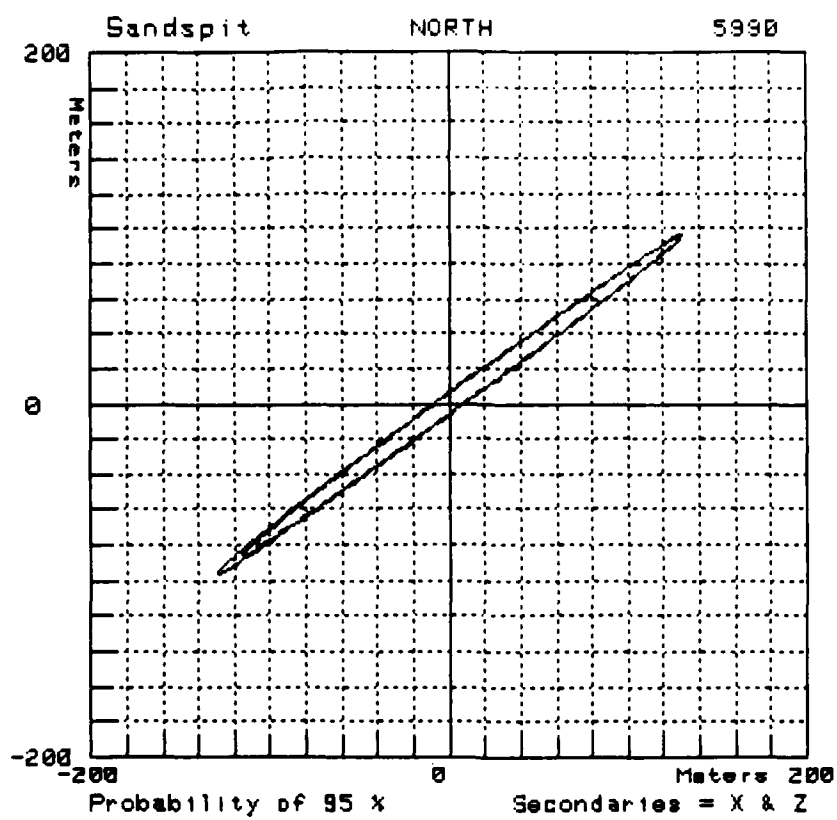
NAD 27
LAT : 55 14 1.3 N
LON : 131 48 43.1 W

Positioning System
From G-NRN

X-LOP: 86.6 deg
Z-LOP: 132.1 deg

Gradients: 992 ft/usec
Gradients: 1801 ft/usec





HMS SITE INFORMATION

TACOMA, WASHINGTON

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 07 September 1982 - 26 January 1984

GRI: 5990 Canadian West Coast Chain

TDY: 27932.366
TDZ: 42230.615

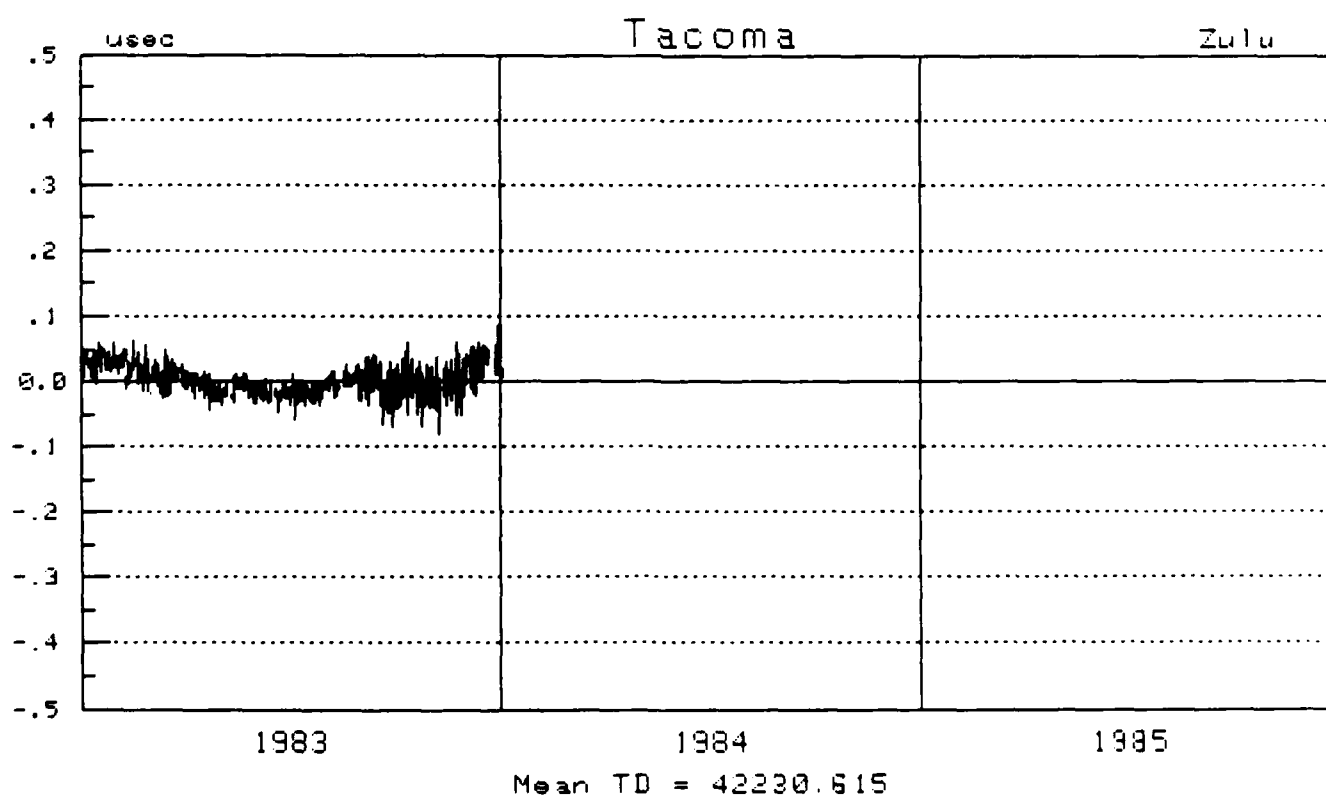
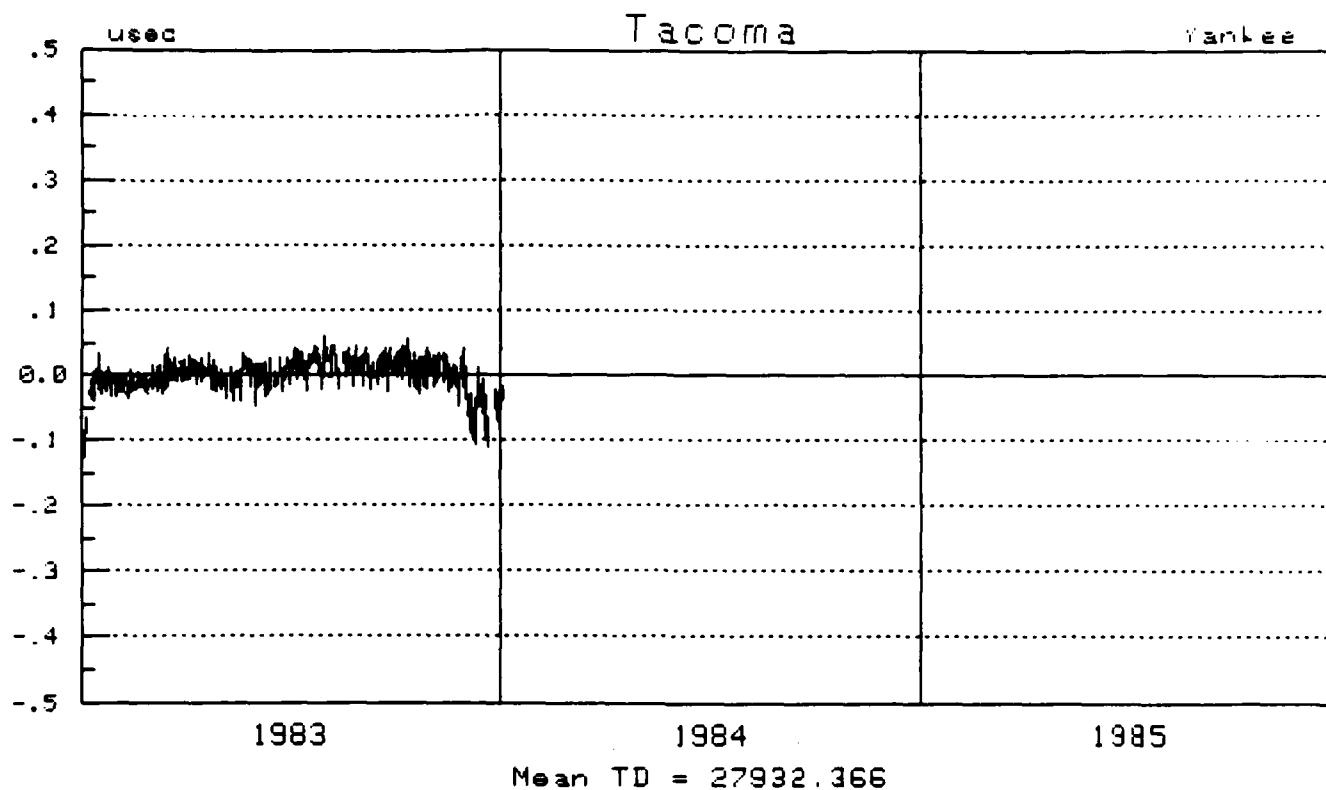
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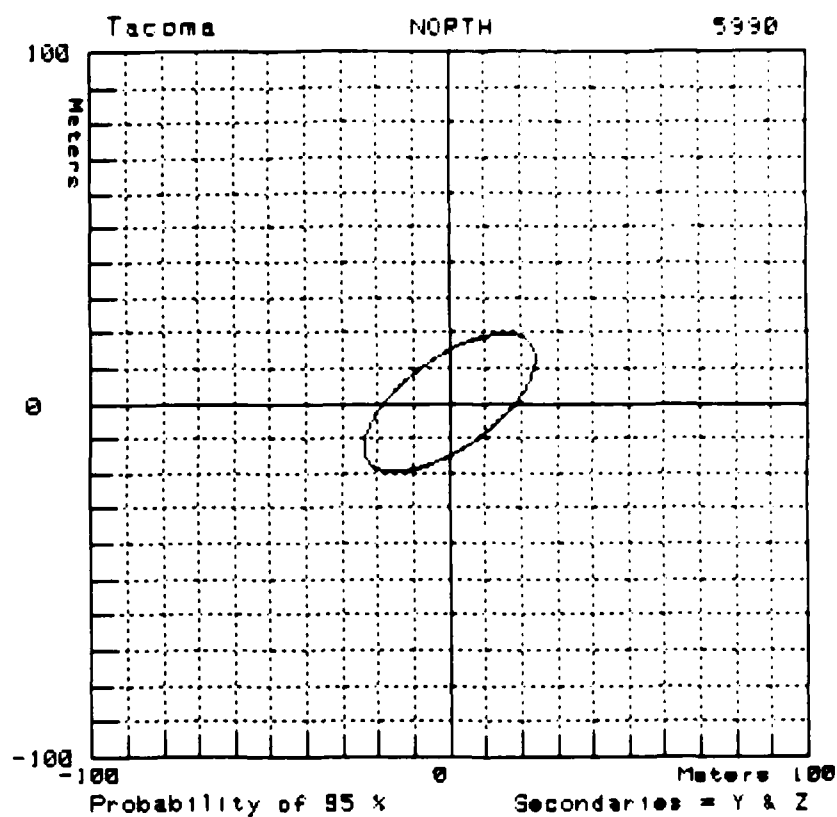
WGS 72
LAT : 47 20 5 N
LON : 122 35 14.9 W

NAD 27
LAT : 47 20 06 N
LON : 122 35 10 W

Positioning System
From Nautical Chart

Y-LOP: 49.3 deg Gradients: 665 ft/usec
Z-LOP: 159.8 deg Gradients: 1320 ft/usec





HMS SITE INFORMATION

WHIDBEY ISLAND, WASHINGTON

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 06 December 1983 - Present

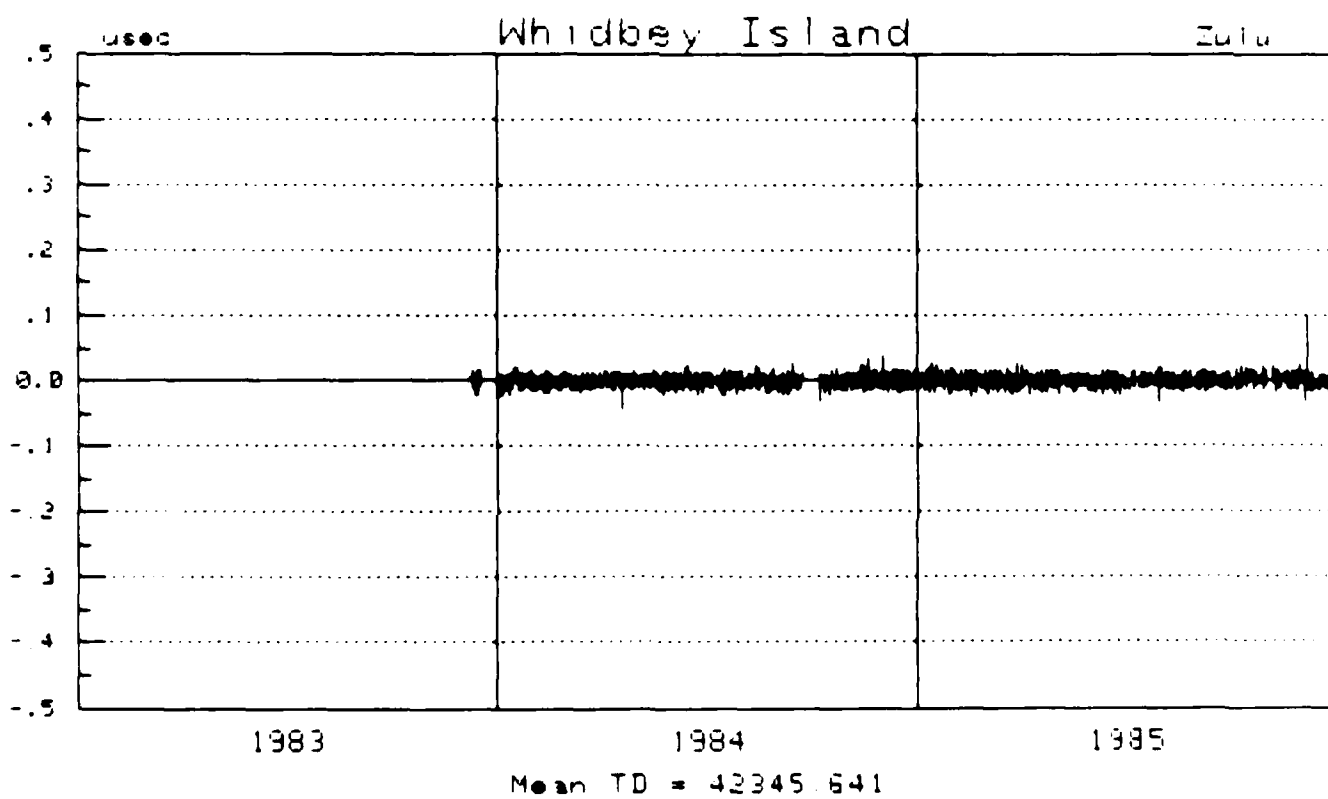
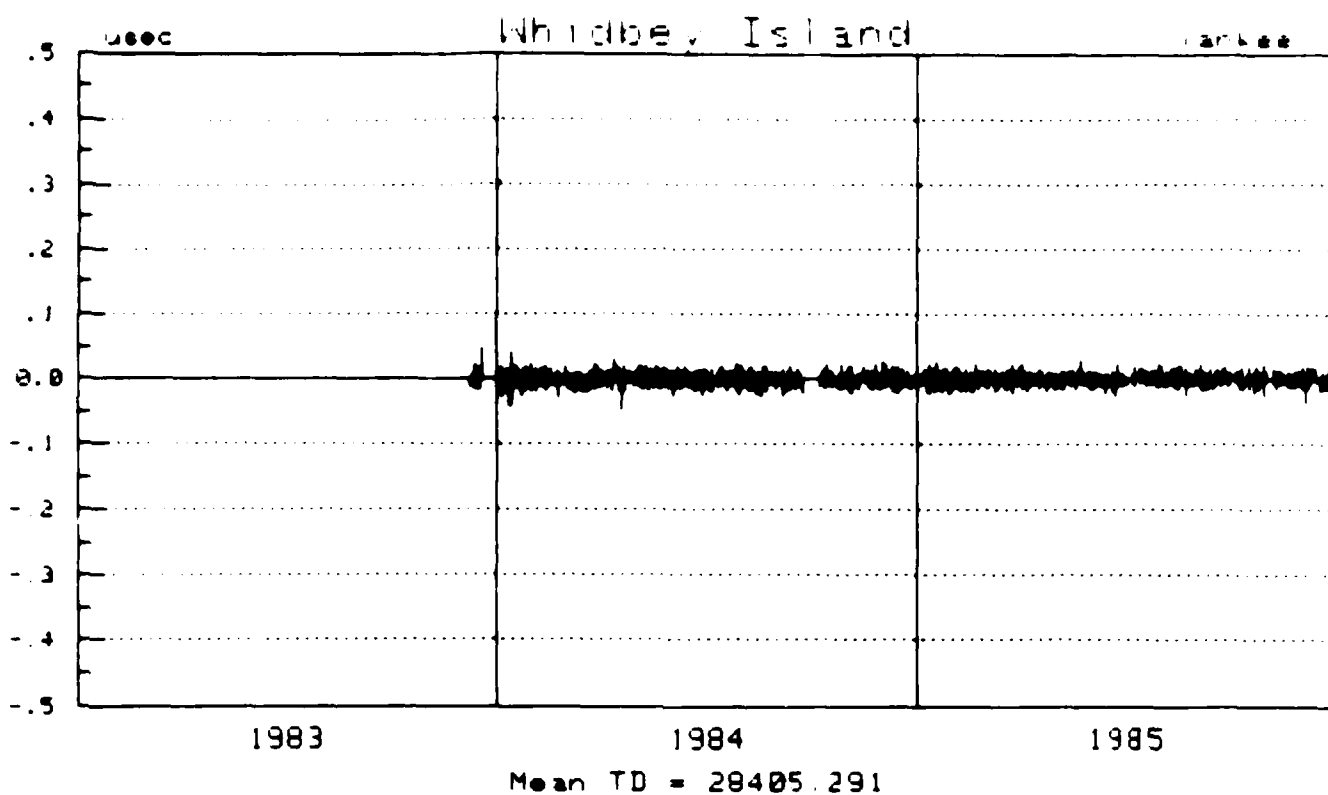
GRI: 5990 Canadian West Coast Chain

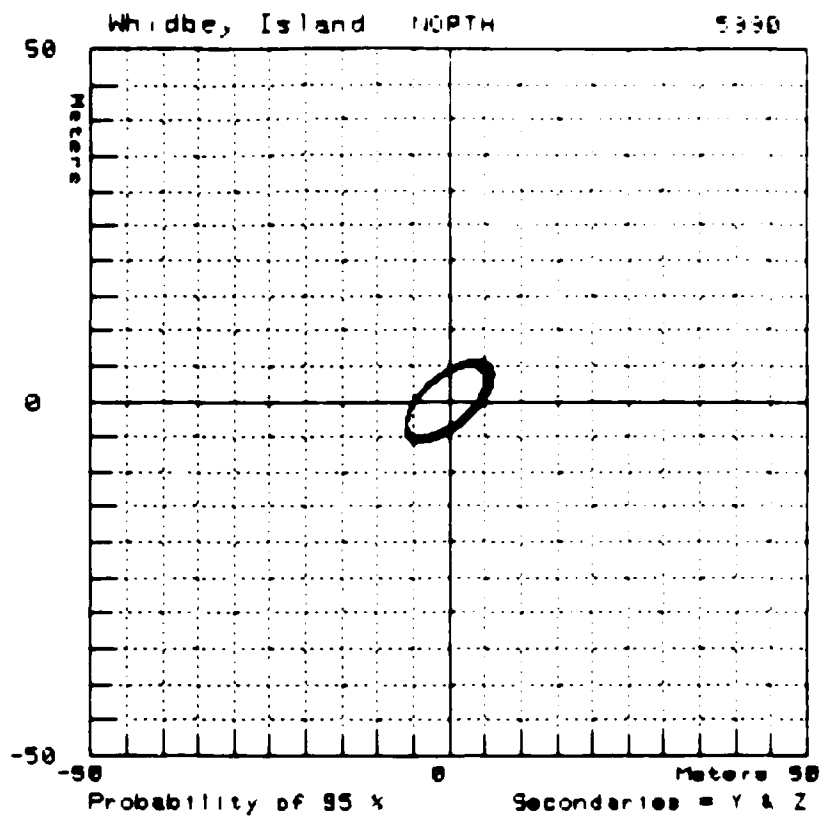
TDY: 28405.290 A1 Control
TDZ: 42345.640 A1 Control

Receiving Antenna Location:

WGS 72	NAD 27	Positioning System
LAT : 48 17 38.5 N	LAT : 48 17 39.46N	From G-NRN
LON : 122 33 59.54W	LON : 122 33 54.54W	

Y-LOP: 61.8 deg	Gradients: 568 ft/usec
Z-LOP: 155.1 deg	Gradients: 1091 ft/usec





HMS SITE INFORMATION

DESTIN, FLORIDA

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 26 August 1981 - 17 March 1985

GRI: 7980 U.S. Southeast Chain

TDX: 30908.285 A2
TDY: 47146.309 A2
TDZ: 64087.183 A2

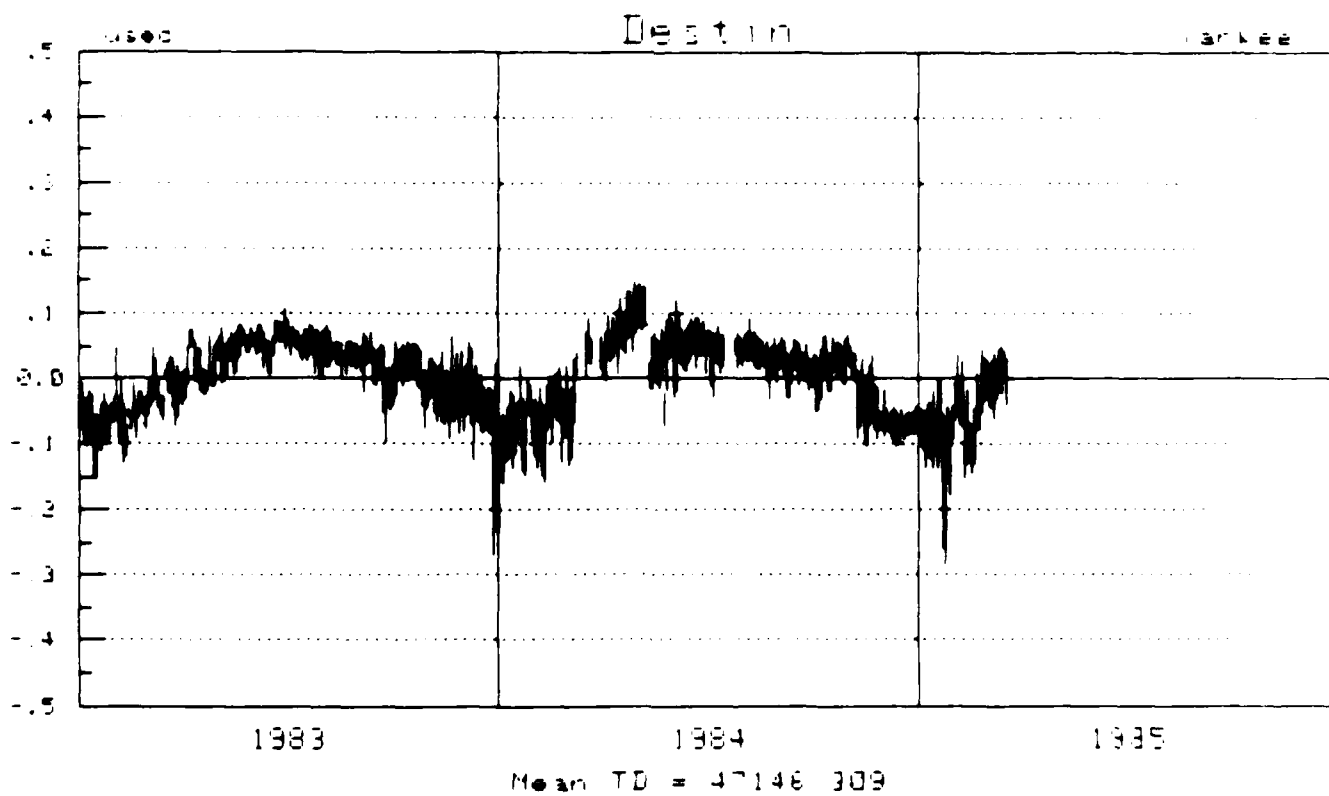
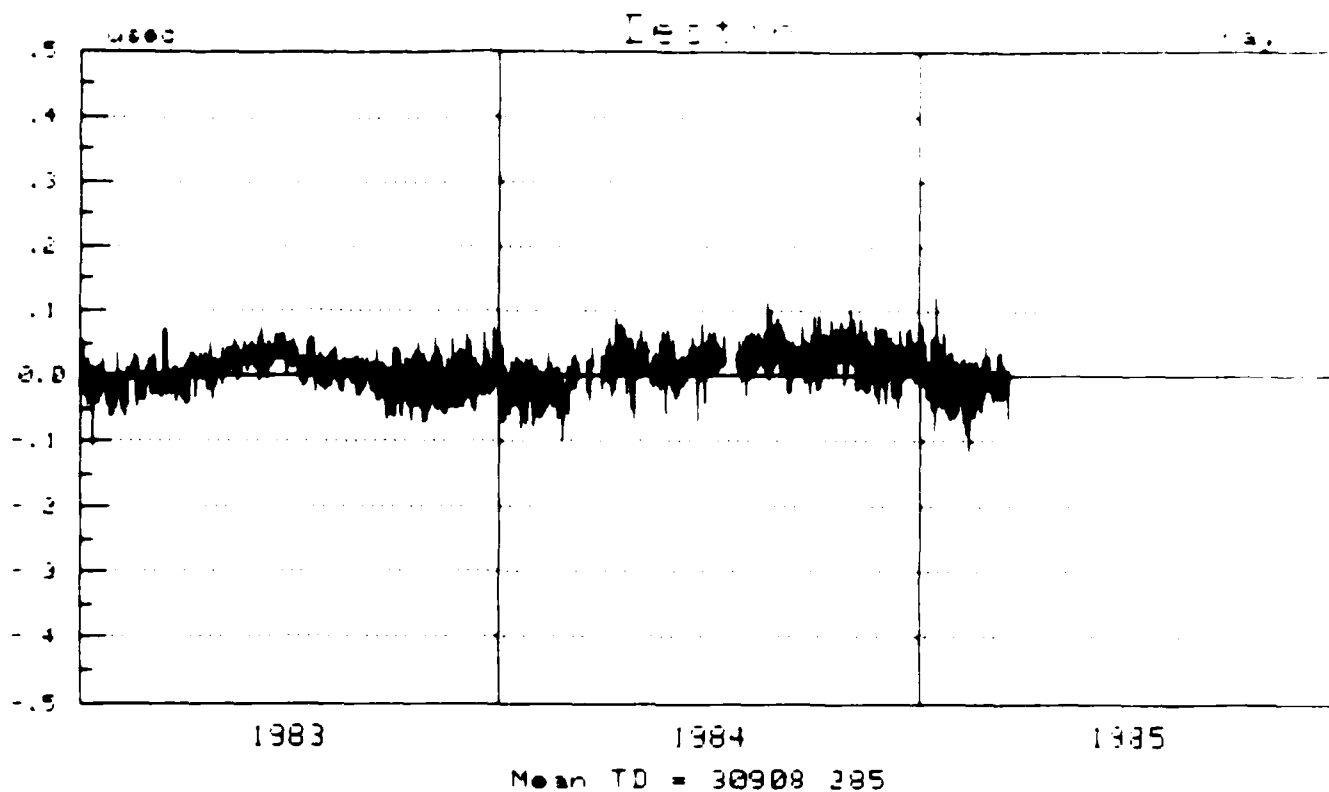
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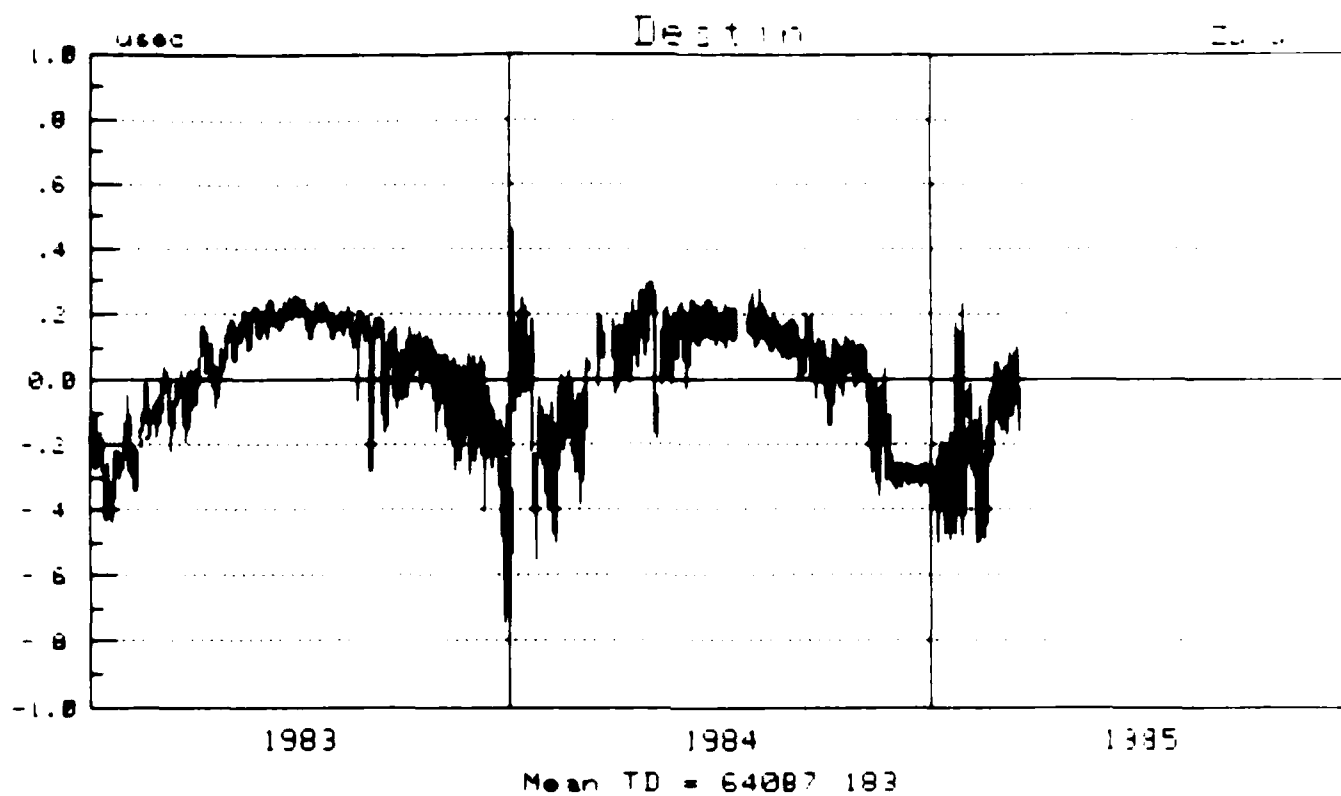
WGS 72
LAT : 30 23 35.54N
LON : 86 32 18.99W

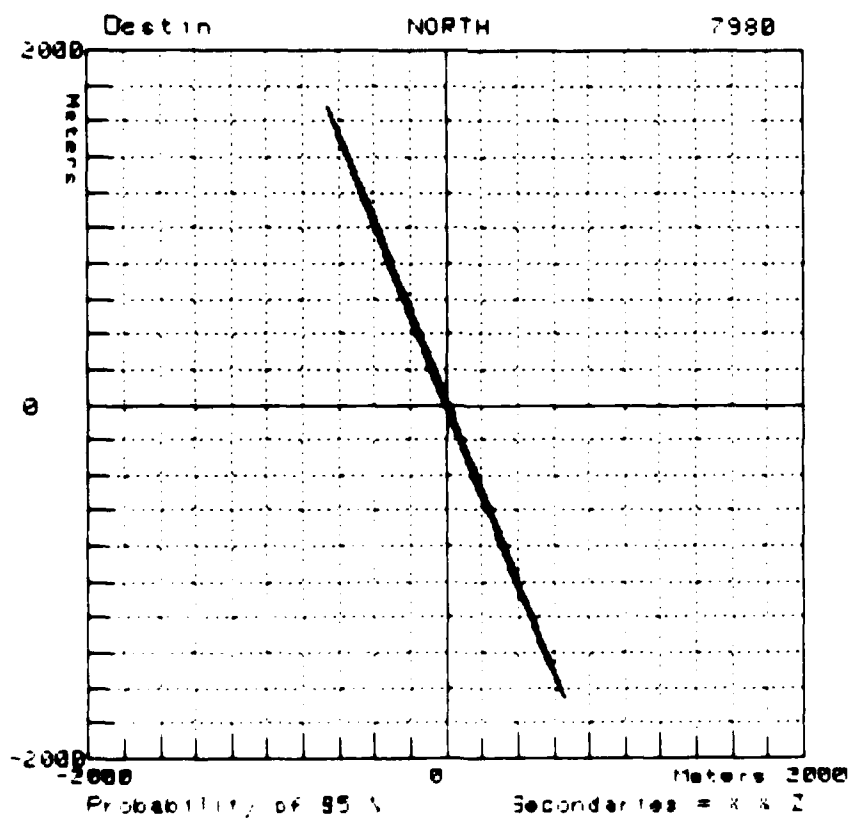
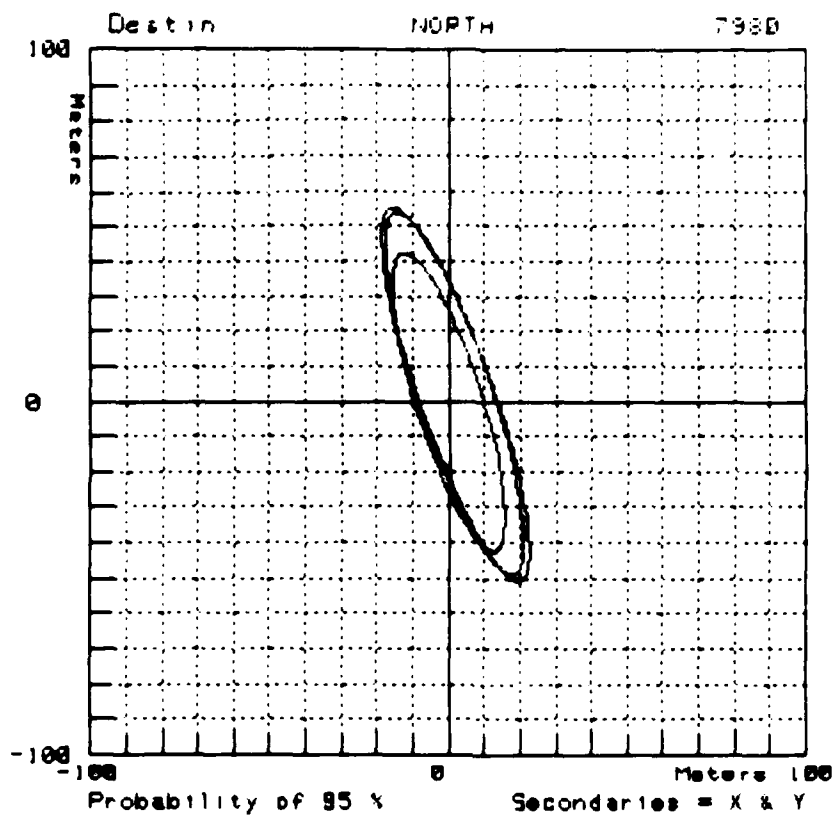
NAD 27
LAT : 30 23 34.75N
LON : 86 32 18.52W

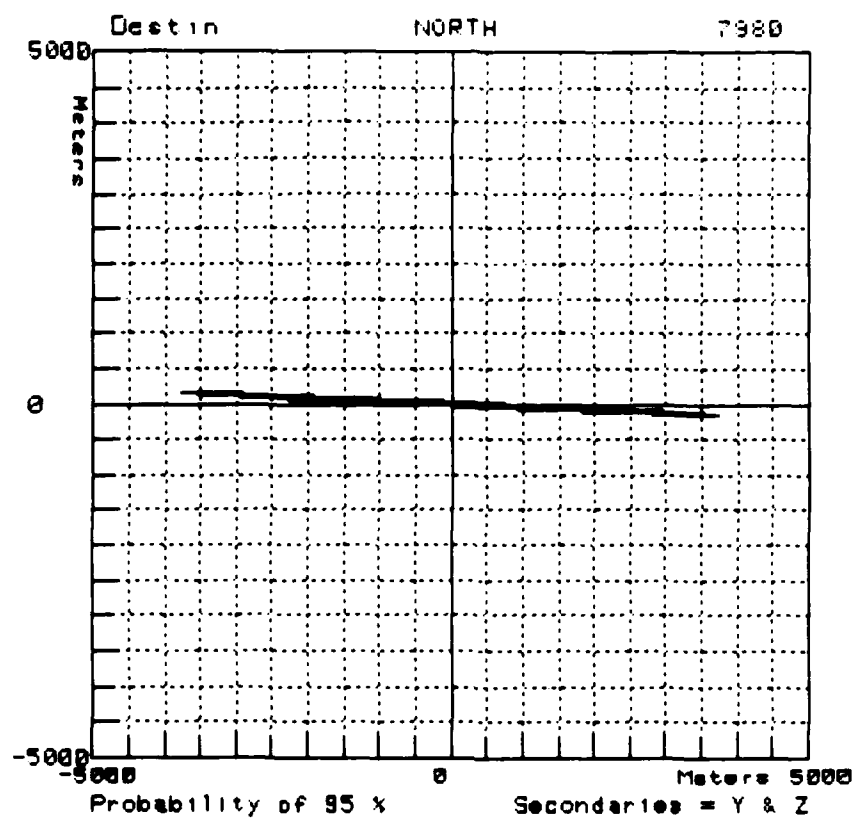
Positioning System
GPS

X-LOP: 157.0 deg	Gradients: 493 ft/usec
Y-LOP: 90.0 deg	Gradients: 1040 ft/usec
Z-LOP: 61.8 deg	Gradients: 37060 ft/usec









HMS SITE INFORMATION

FOLLY BEACH, SOUTH CAROLINA

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 23 April 1982 - Present

GRI: 7980 U.S. Southeast Chain

TDW: 14565.499
TDY: 45510.469
TDZ: 60557.071

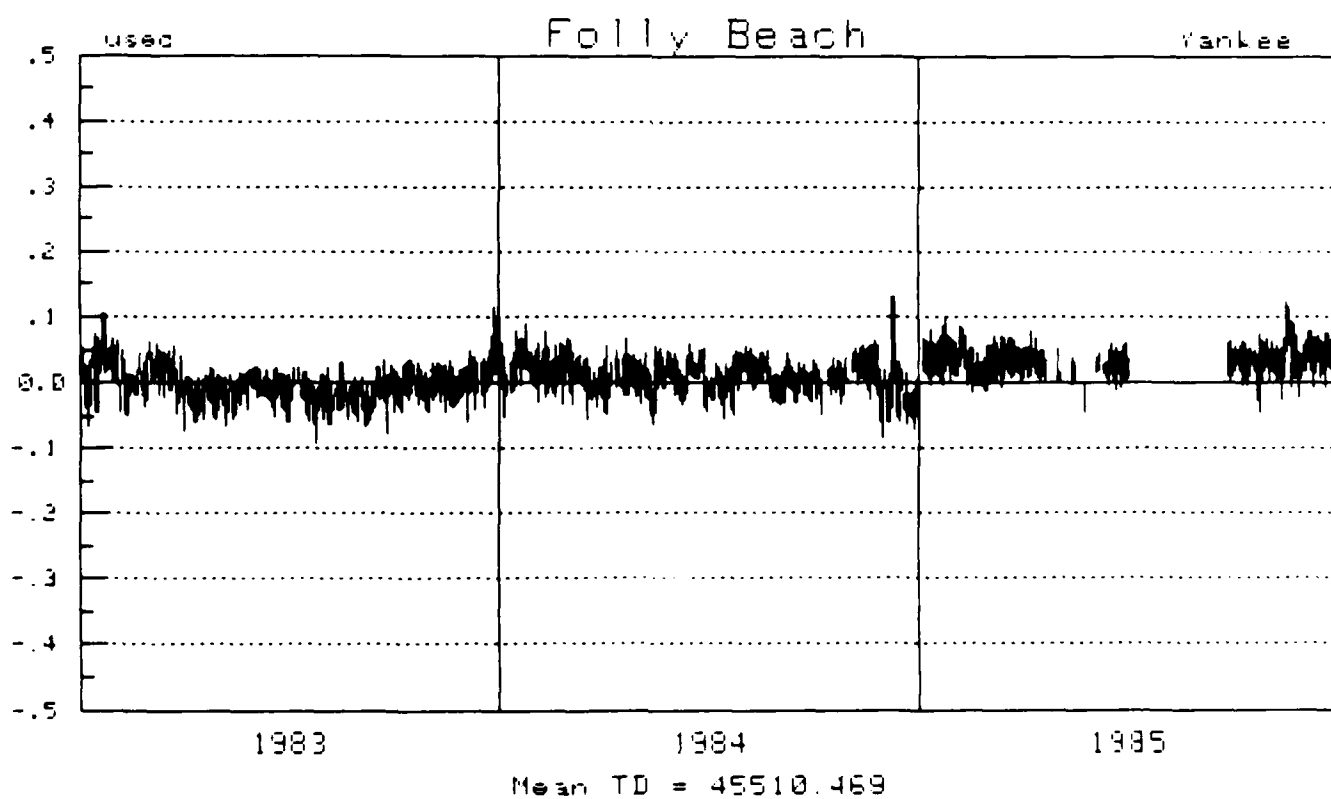
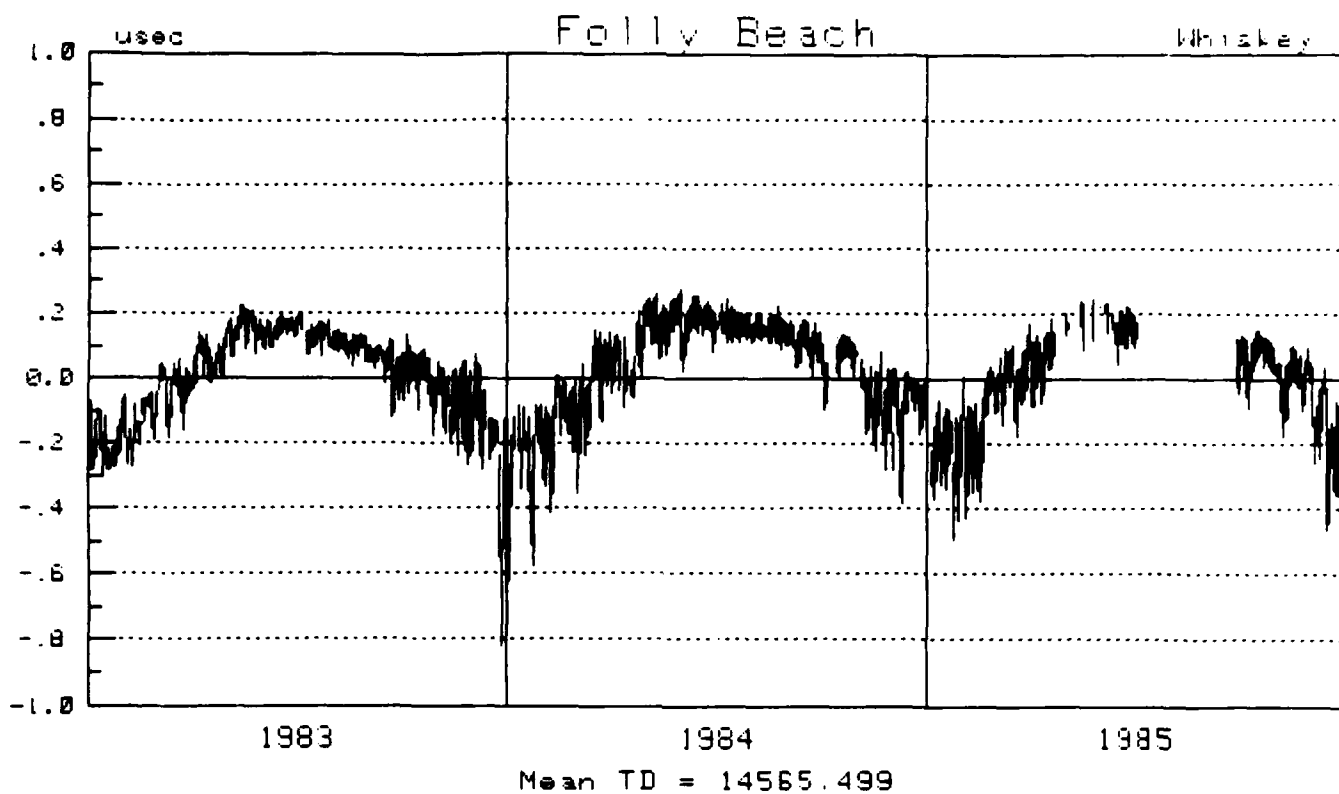
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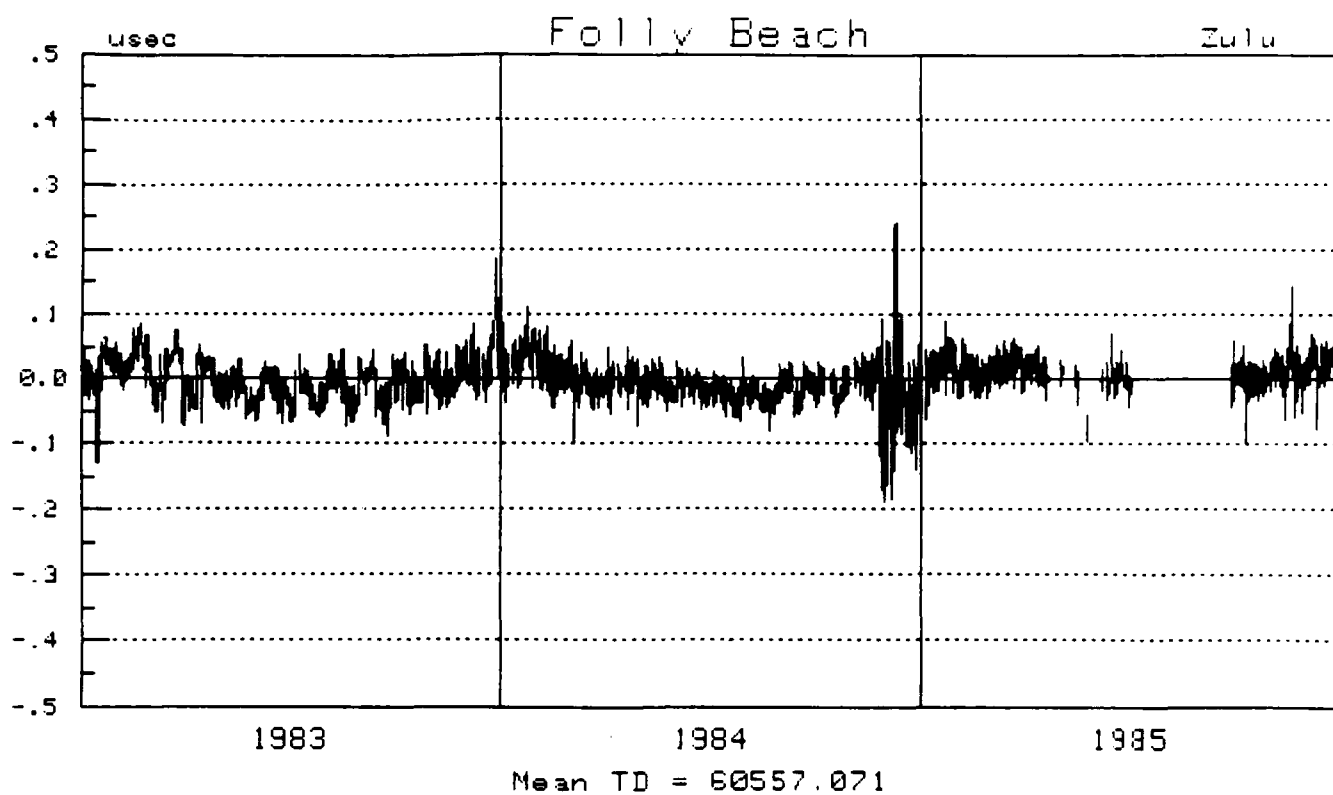
WGS 72
LAT : 32 41 01.73N
LON : 79 53 19.01W

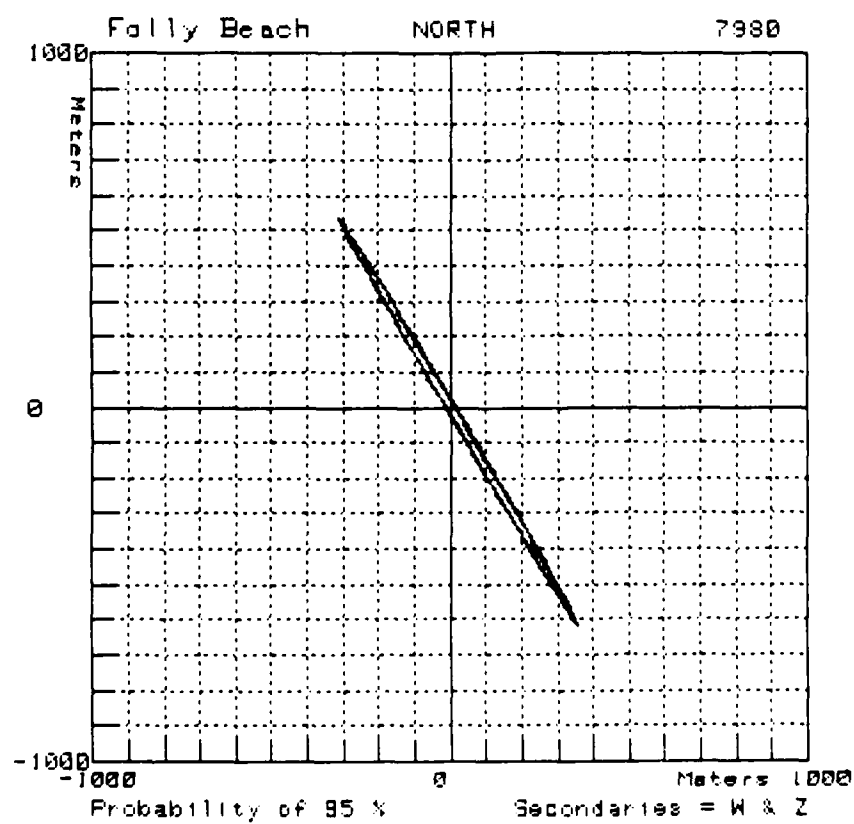
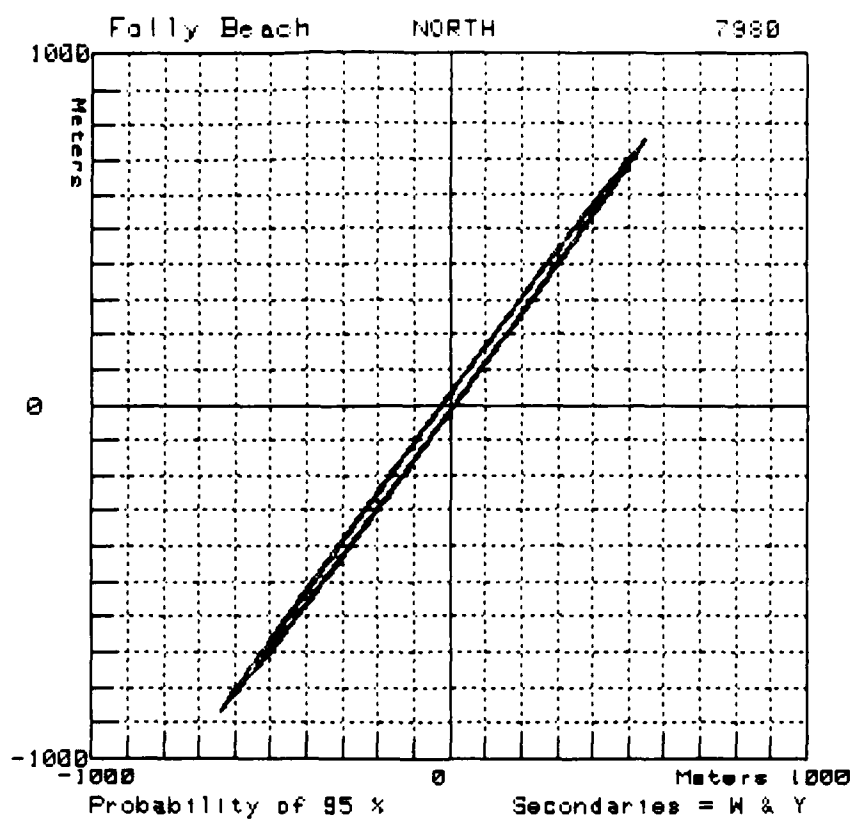
NAD 27
LAT : 32 41 01.16N
LON : 79 53 19.24W

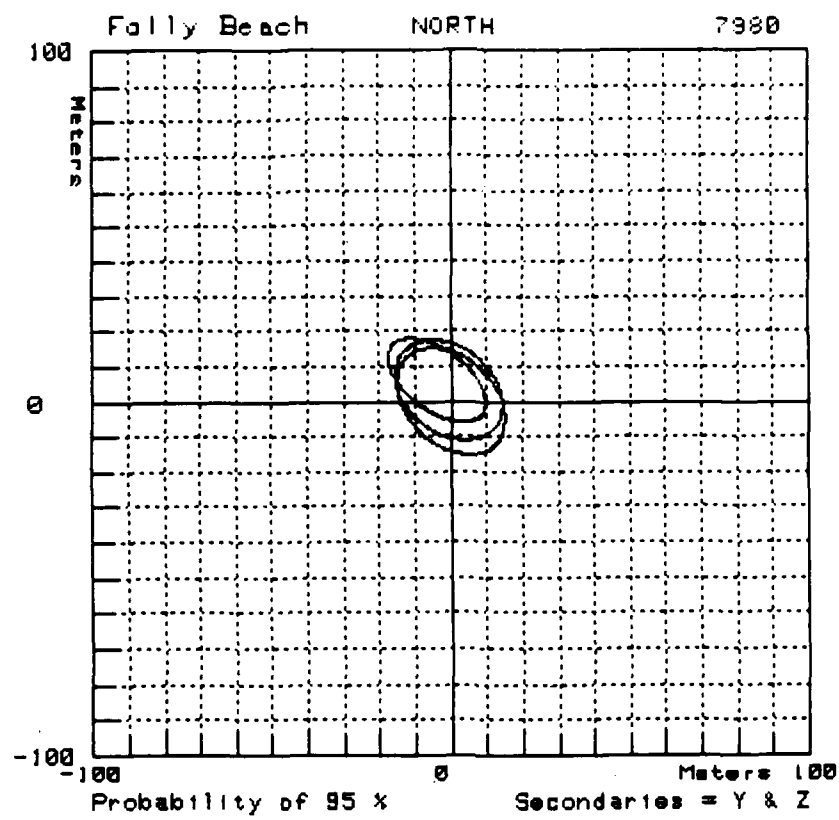
Positioning System
GPS

W-LOP: 255.9 deg	Gradients: 5498 ft/usec
Y-LOP: 216.3 deg	Gradients: 869 ft/usec
Z-LOP: 150.2 deg	Gradients: 500 ft/usec









HMS SITE INFORMATION

GALVESTON, TEXAS

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 27 April 1982 - September 1986

GRI: 7980 U.S. Southeast Chain

TDW: 11030.269
TDX: 25737.983
TDY: 46928.831

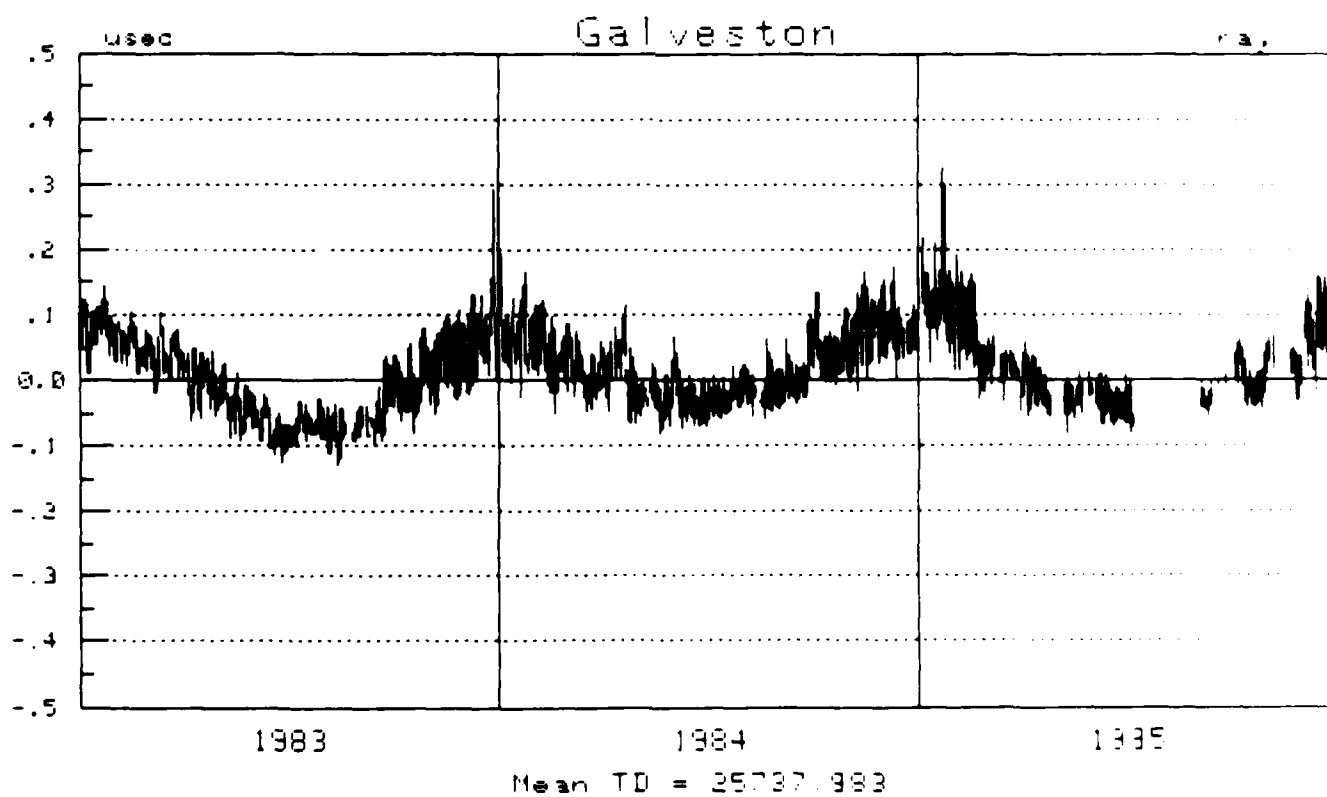
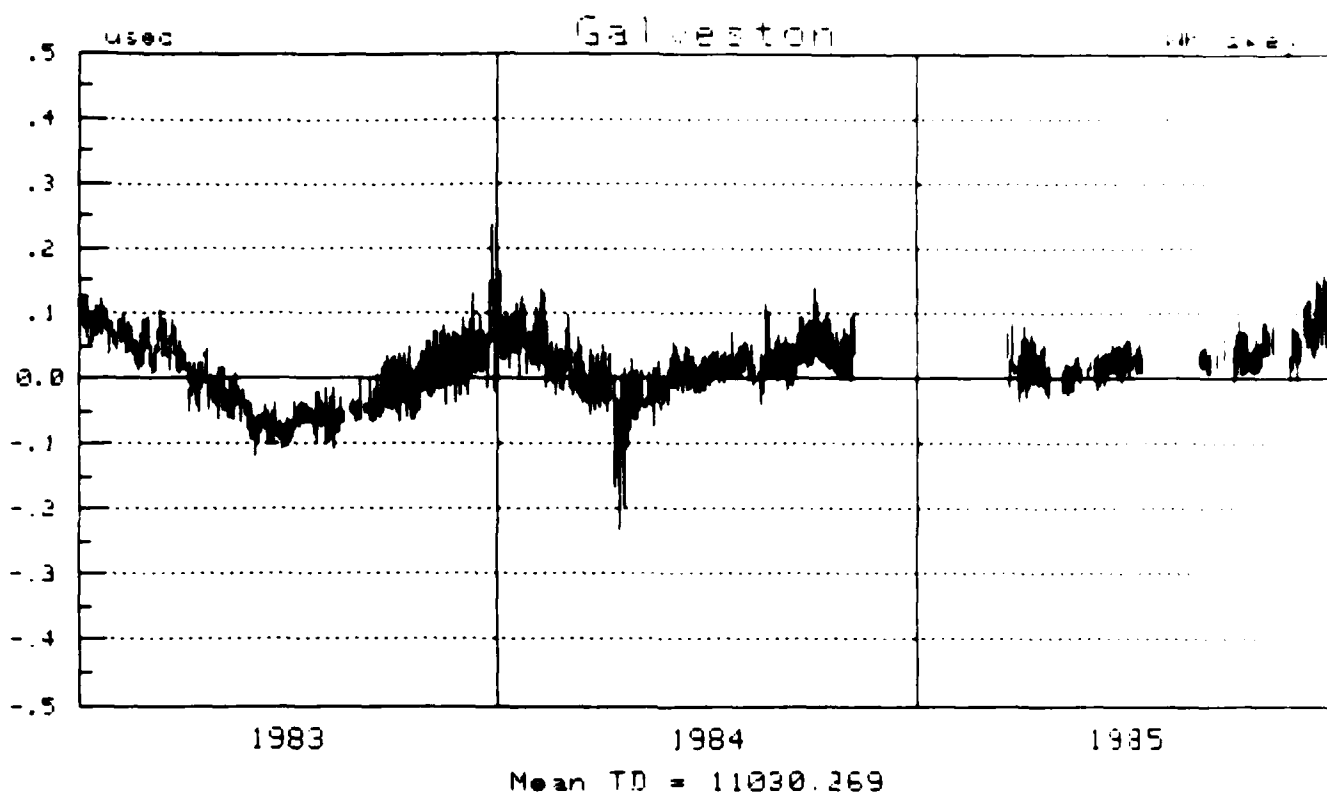
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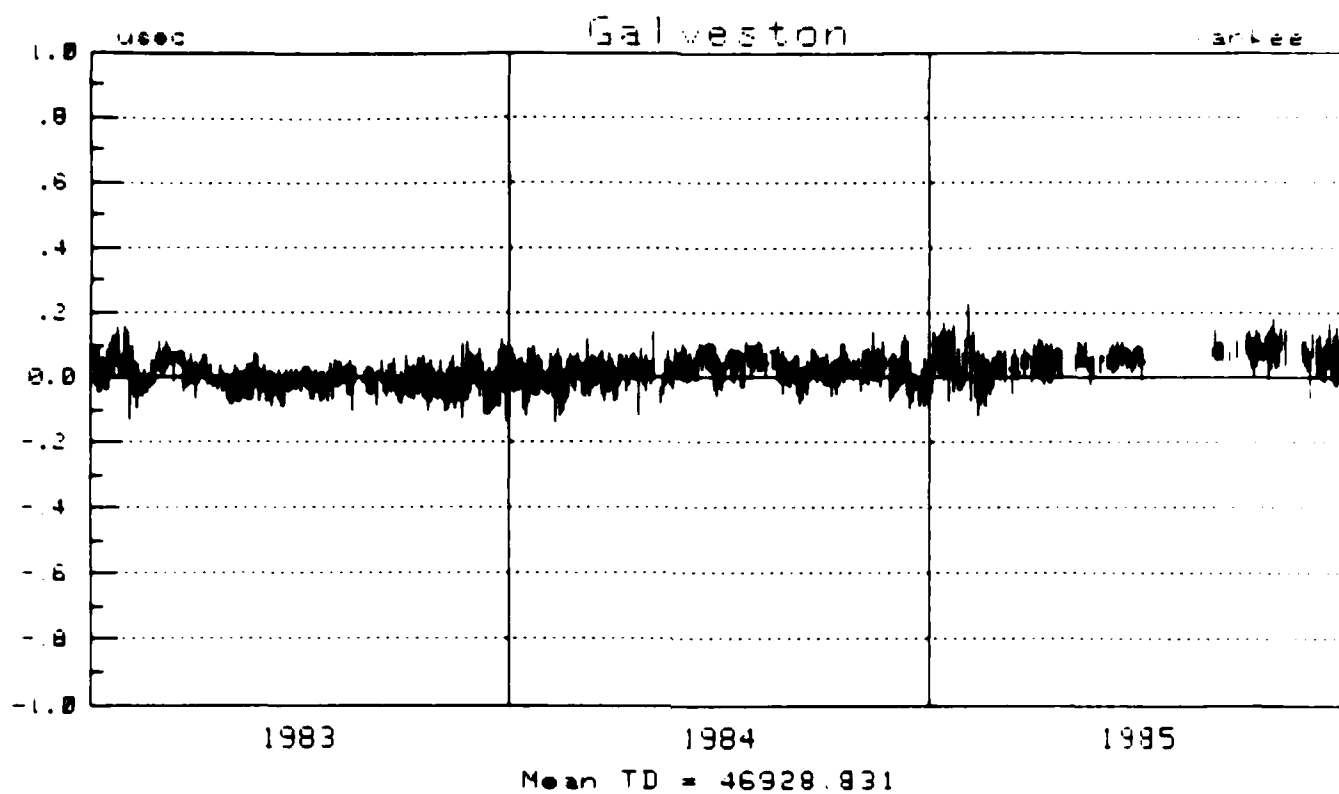
WGS 72
LAT : 29 19 58.32N
LON : 94 46 15.95W

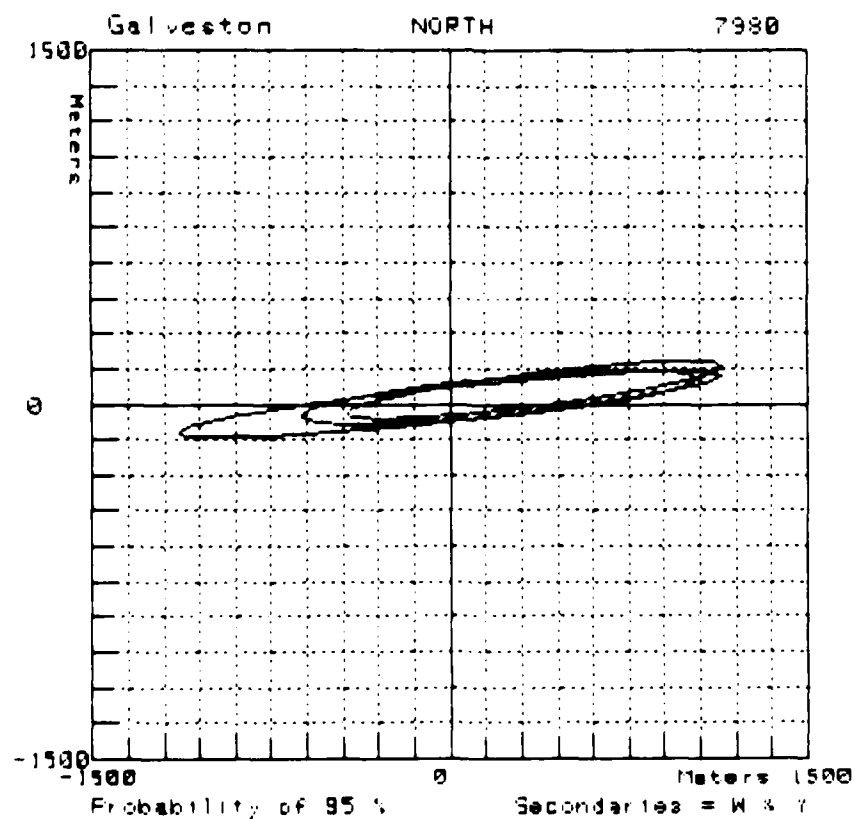
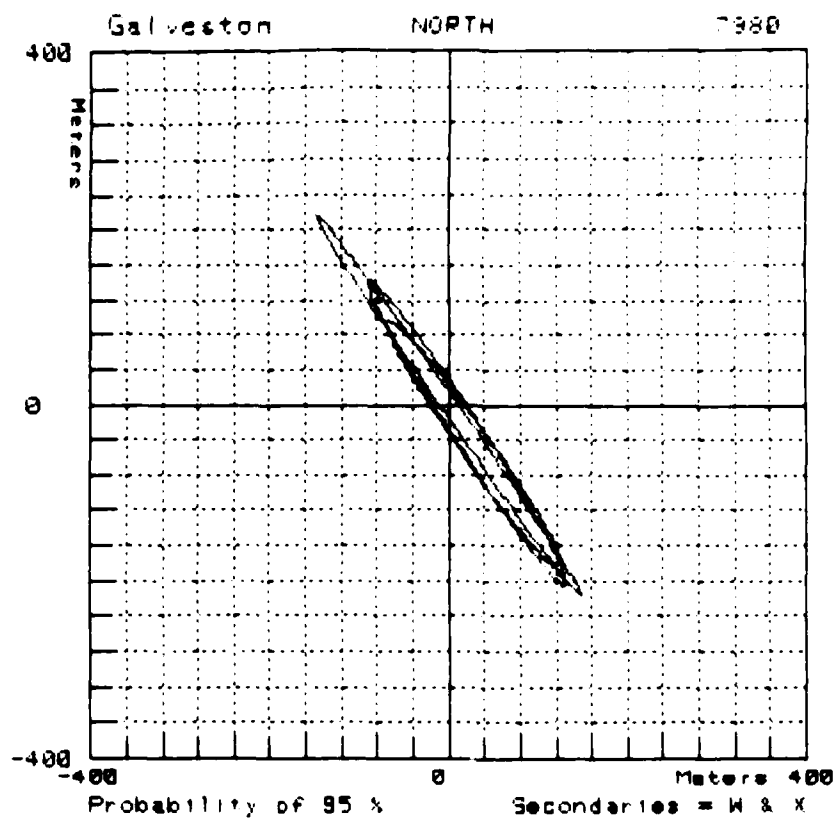
NAD 27
LAT : 29 19 57.47N
LON : 94 46 14.65W

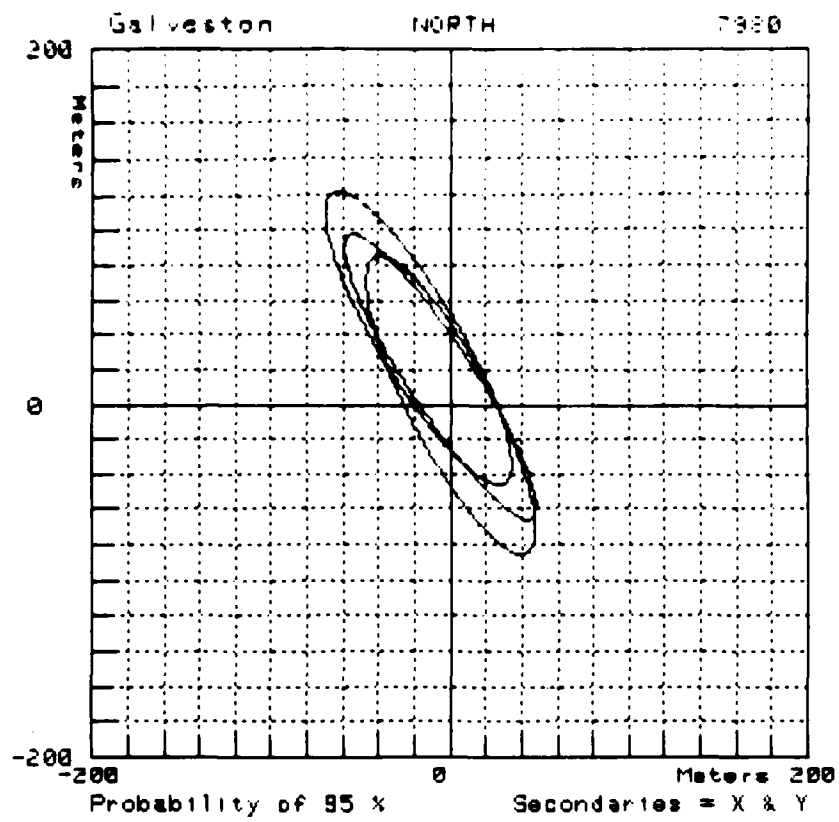
Positioning System
GPS

W-LOP: 71.6 deg	Gradients: 5981 ft/usec
X-LOP: 150.5 deg	Gradients: 511 ft/usec
Y-LOP: 86.4 deg	Gradients: 2808 ft/usec









HMS SITE INFORMATION

MARATHON KEY, FLORIDA

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 13 May 1983 - 23 April 1985

GRI: 7980 U.S. Southeast Chain

TDW: 14023.881
TDY: 43441.764
TDZ: 62473.121

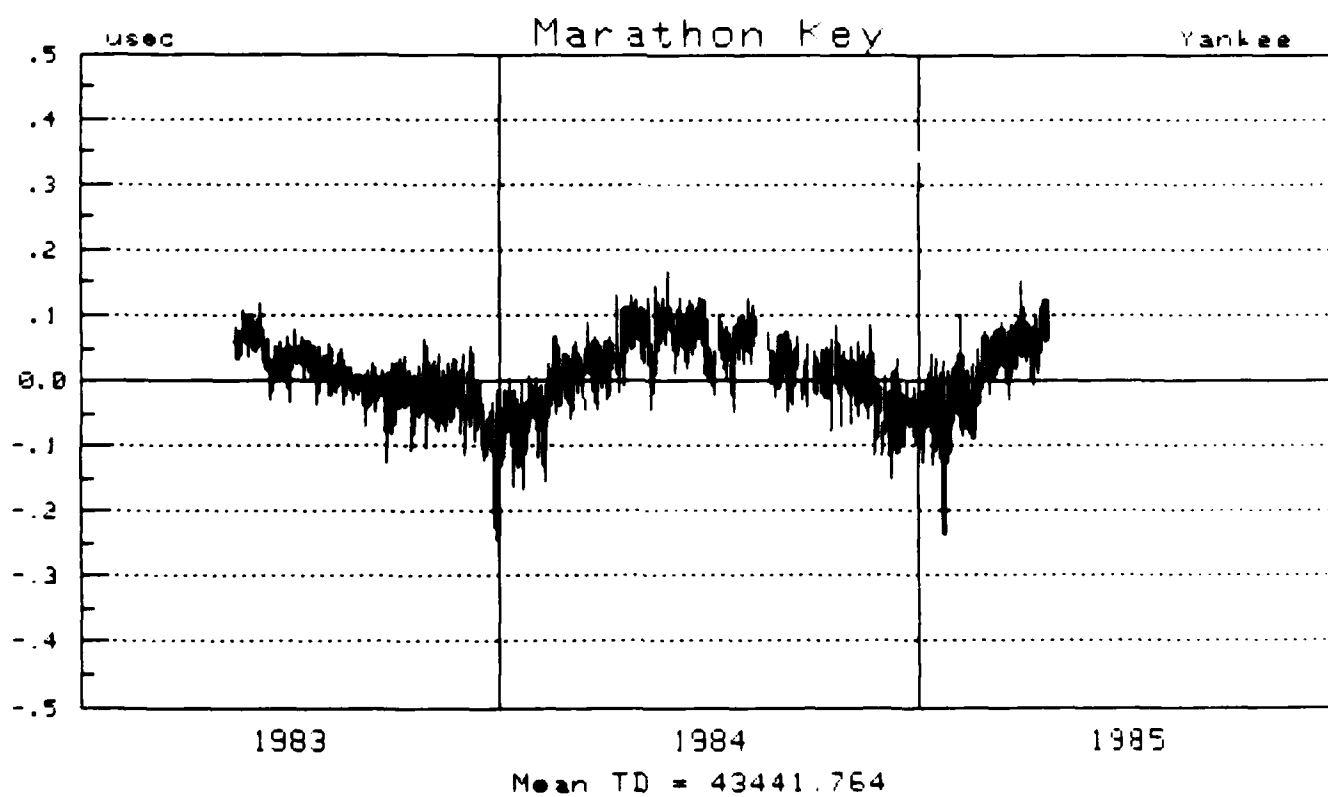
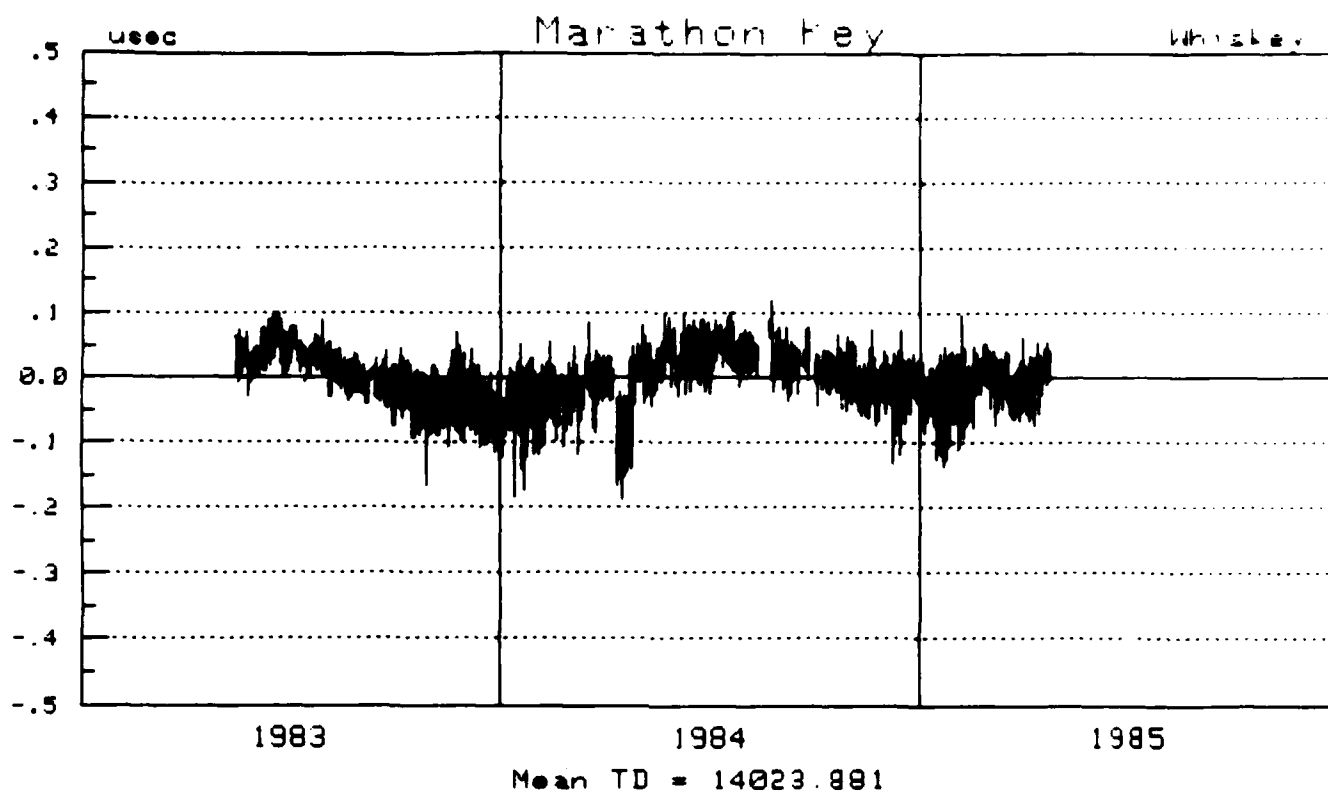
Receiving Antenna Location:

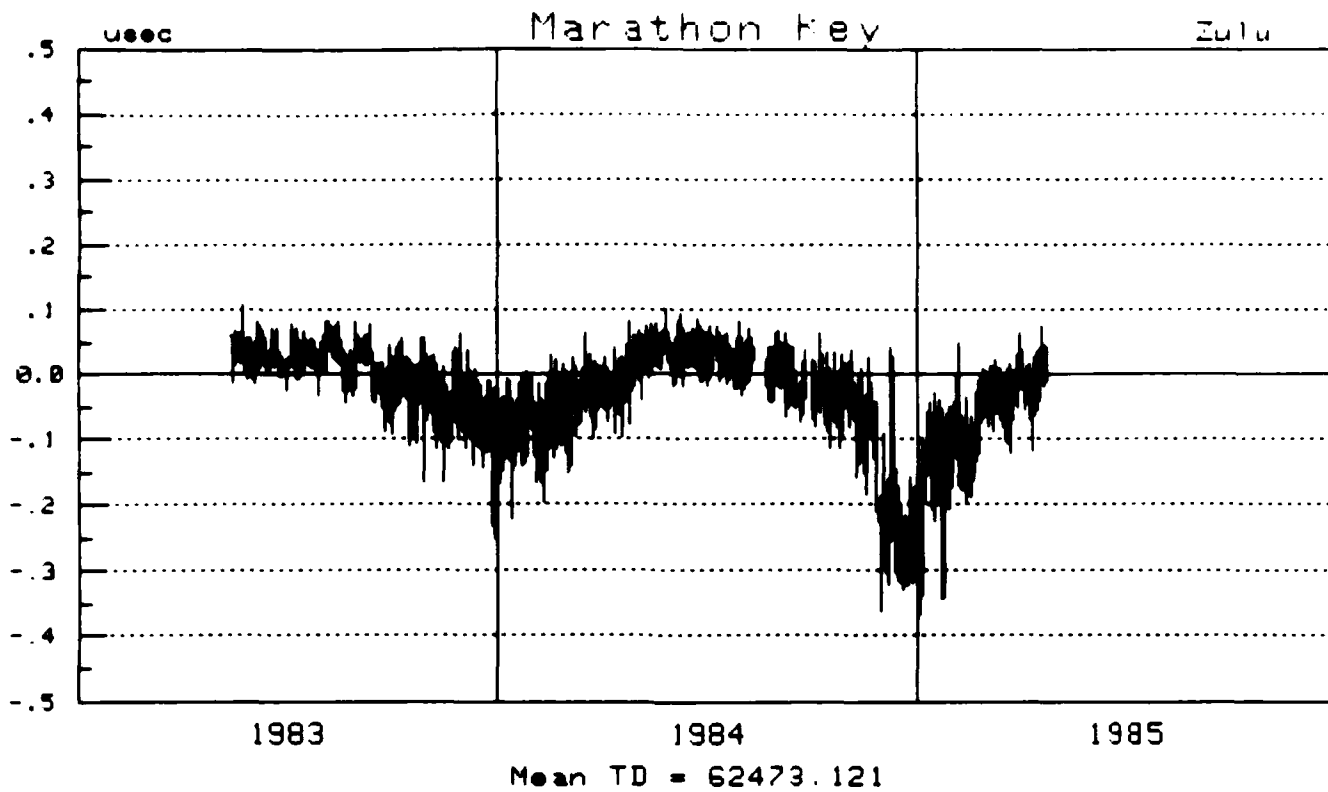
WGS 72
LAT : 24 42 33.46N
LON : 81 06 22.63W

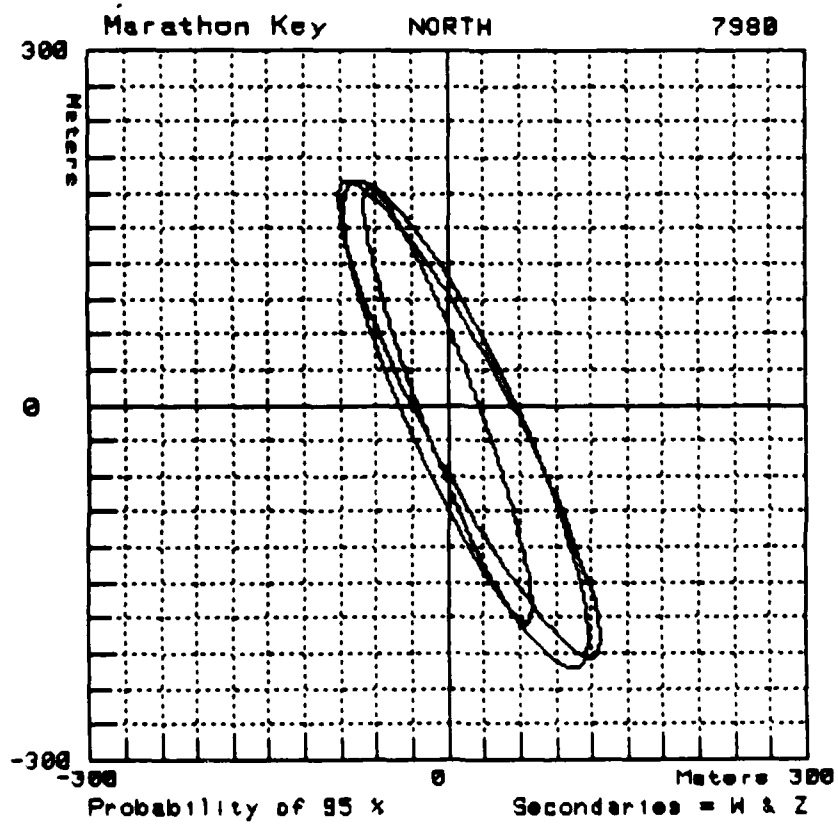
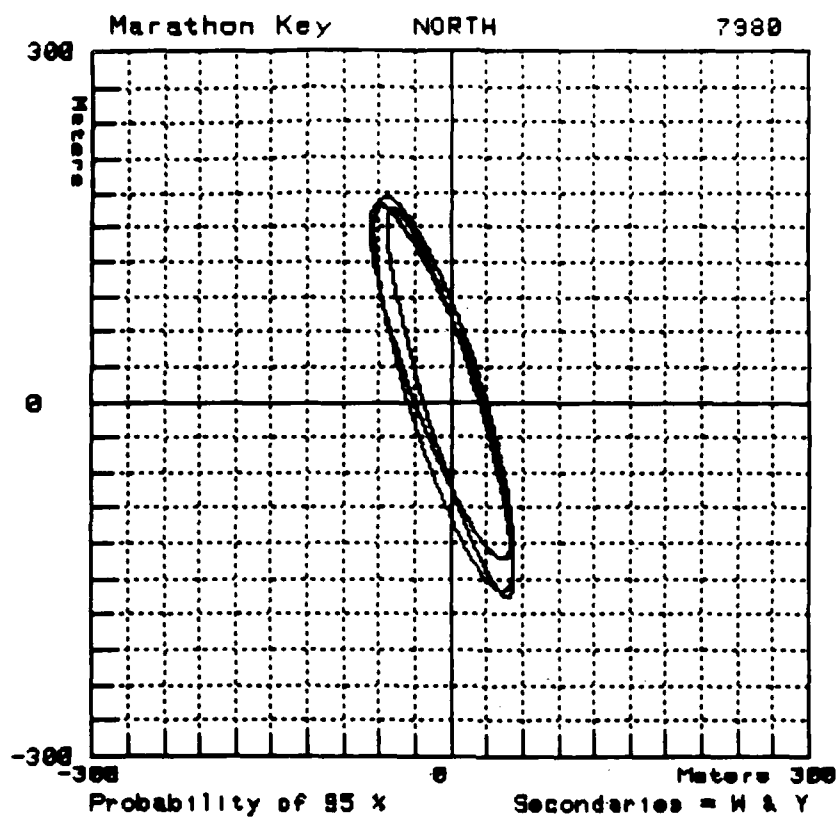
NAD 27
LAT : 24 42 31.97N
LON : 81 06 22.72W

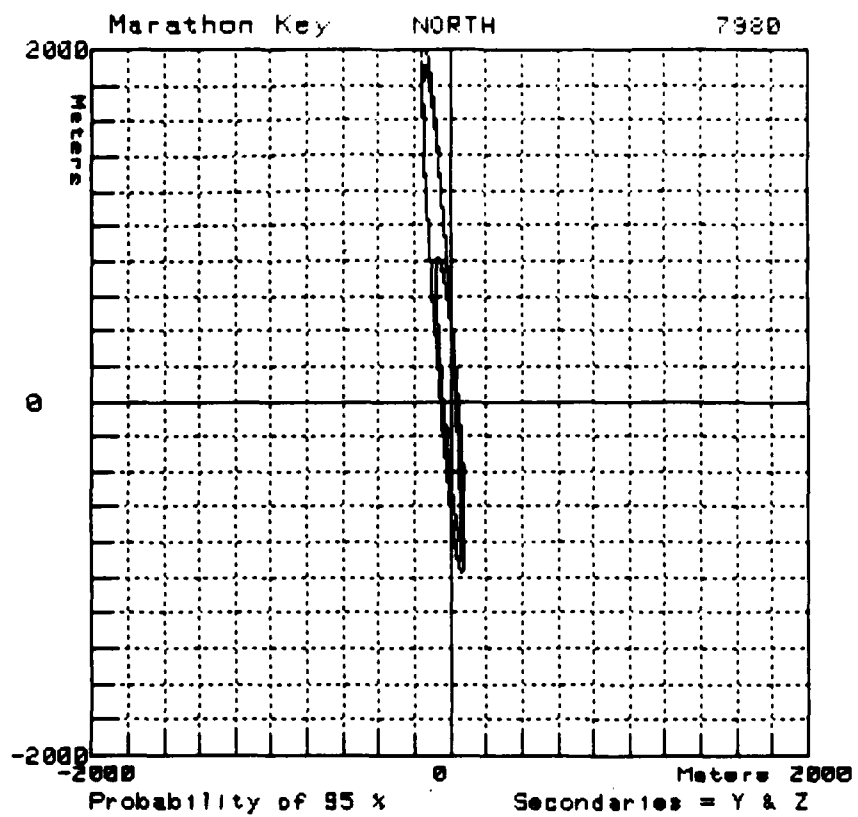
Positioning System
GPS

W-LOP: 319.2 deg	Gradients: 2370 ft/usec
Y-LOP: 175.6 deg	Gradients: 1183 ft/usec
Z-LOP: 173.4 deg	Gradients: 1294 ft/usec









HMS SITE INFORMATION

MAYPORT, FLORIDA

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 28 September 1983 - 17 March 1985

GRI: 7980 U.S. Southeast Chain

TDW: 14607.034 A2
TDY: 45290.718 A1 Control
TDZ: 62073.388 A1 Control

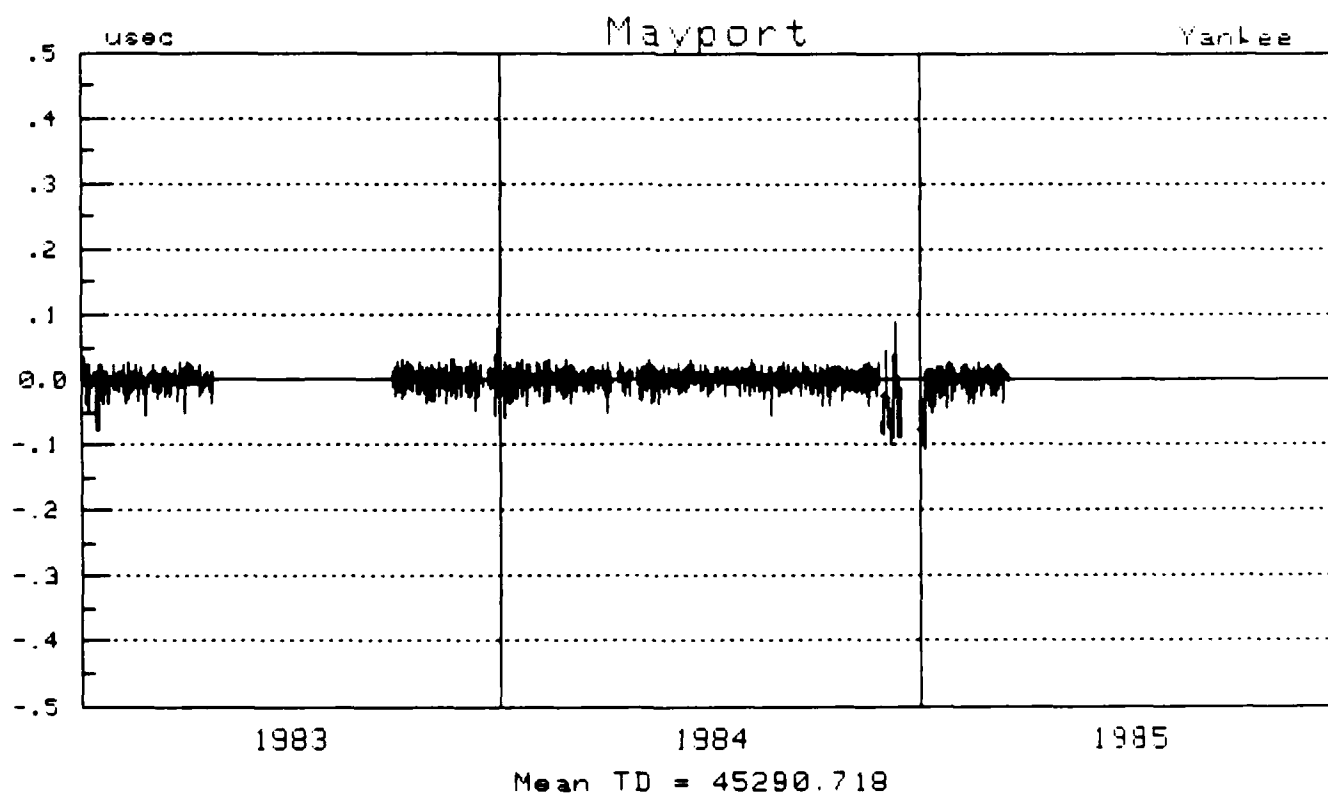
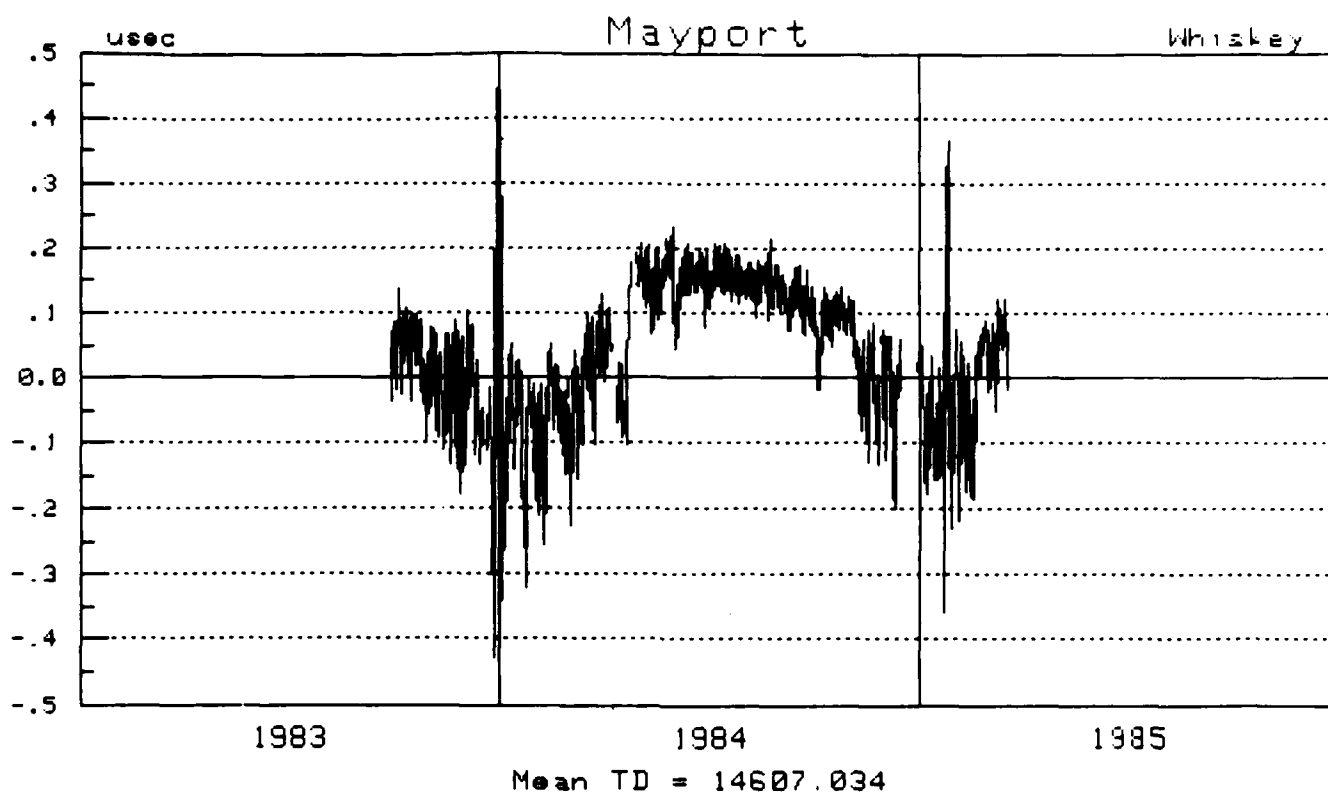
Receiving Antenna Location:

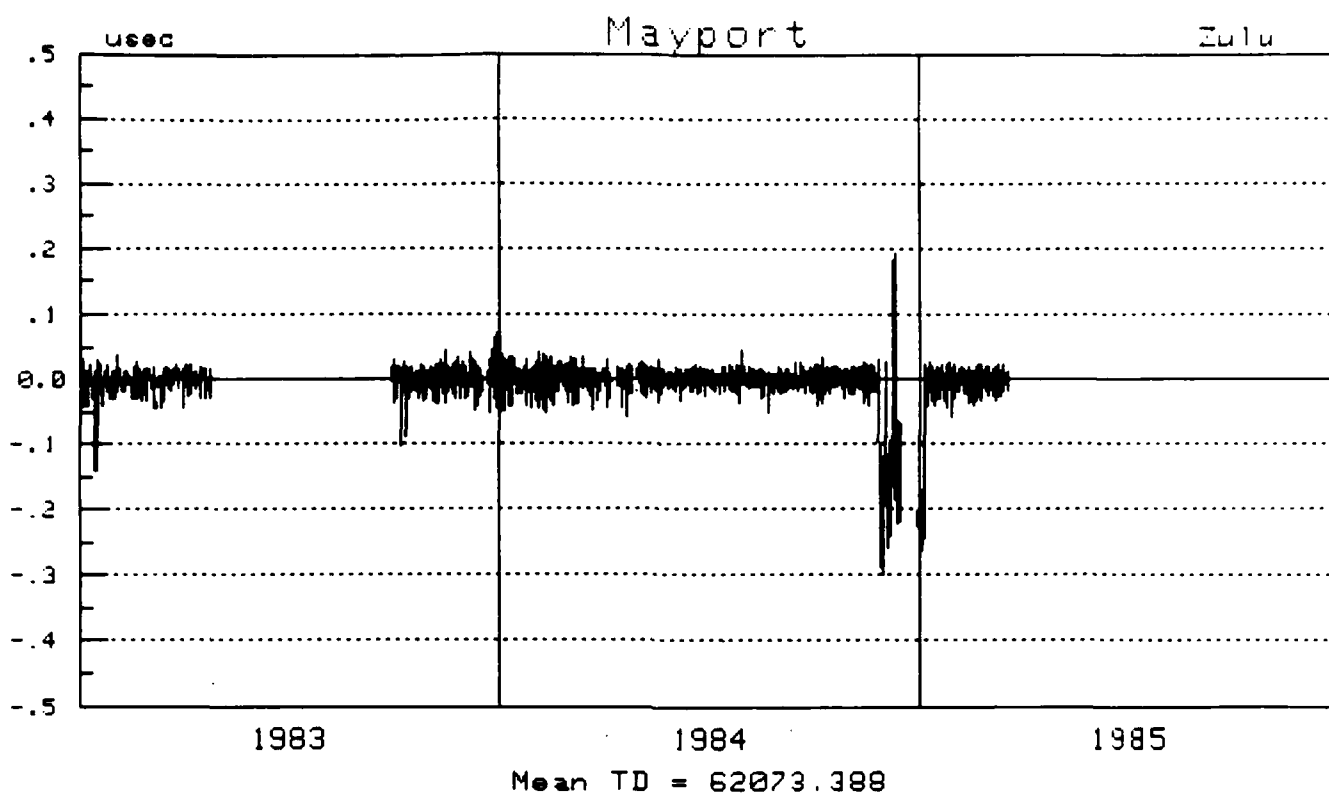
WGS 72
LAT : 30 22 58.85N
LON : 81 25 13.10W

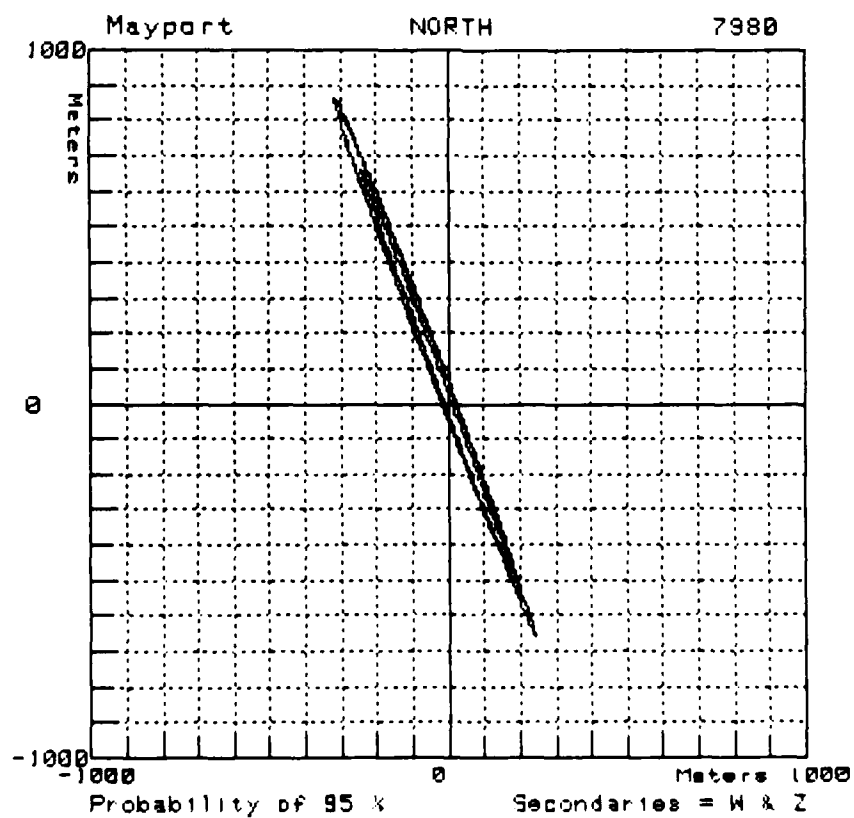
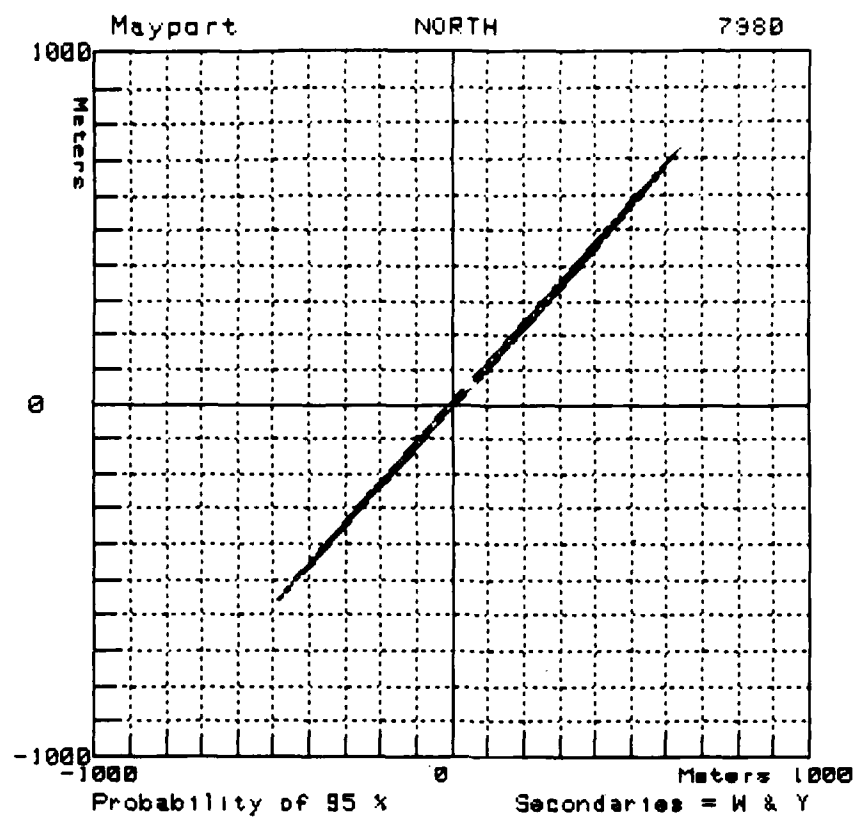
NAD 27
LAT : 30 22 58.05N
LON : 81 25 13.16W

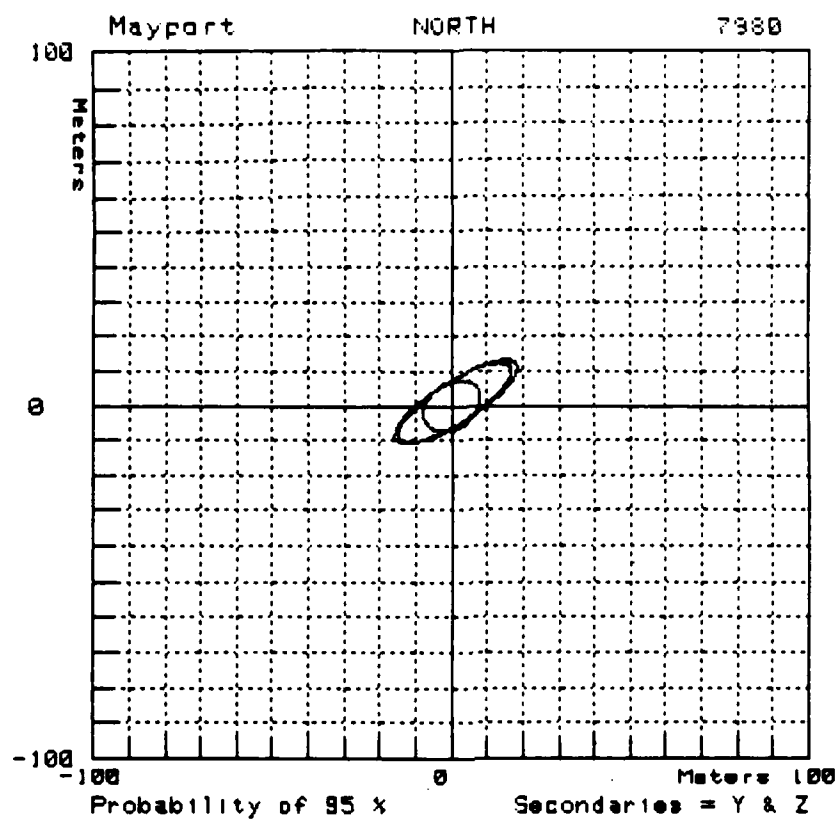
Positioning System
From G-NRN

W-LOP: 287.2 deg	Gradients: 8249 ft/usec
Y-LOP: 221.2 deg	Gradients: 565 ft/usec
Z-LOP: 159.9 deg	Gradients: 578 ft/usec









HMS SITE INFORMATION

MORGAN'S POINT, TEXAS

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 12 April 1984 - 23 February 1985

GRI: 7980 U.S. Southeast Chain

TDW: 11010.749
TDX: 25747.242
TDY: 46982.955

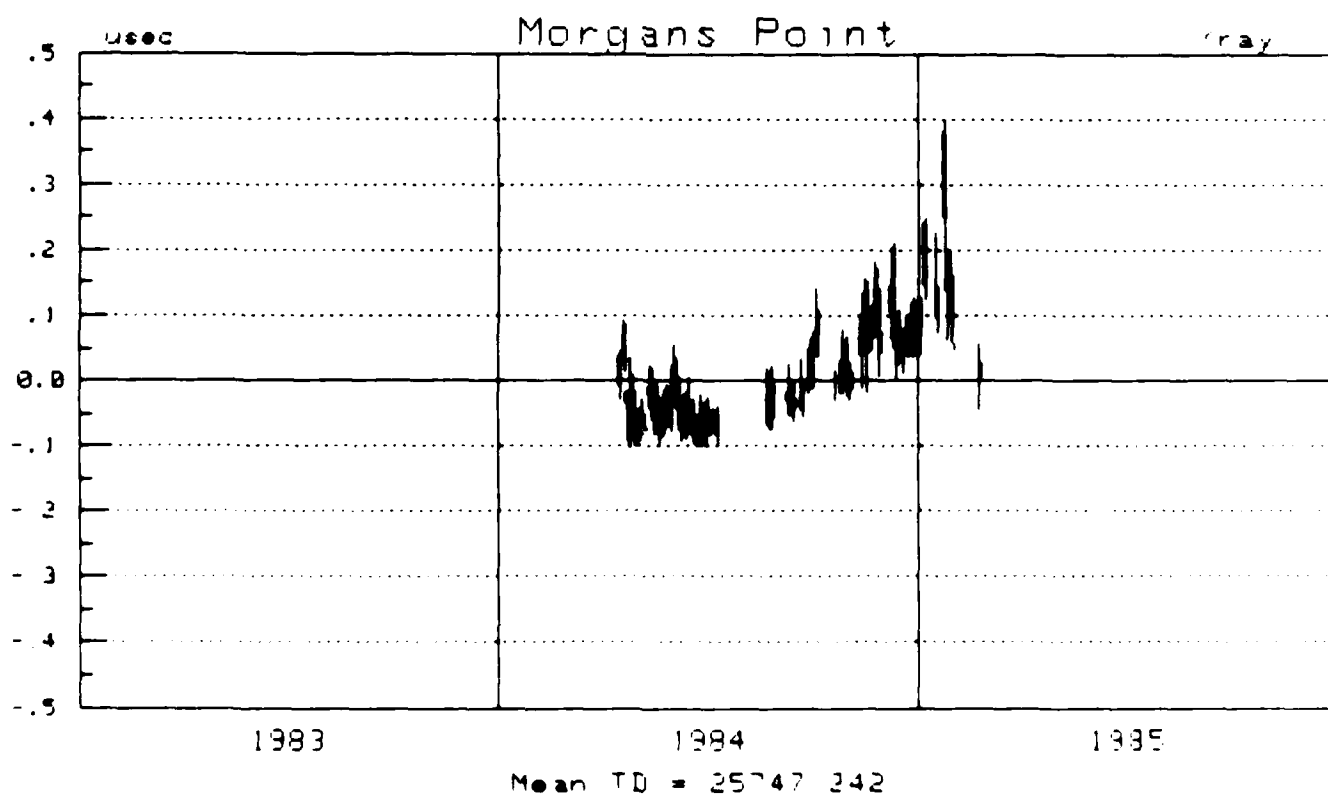
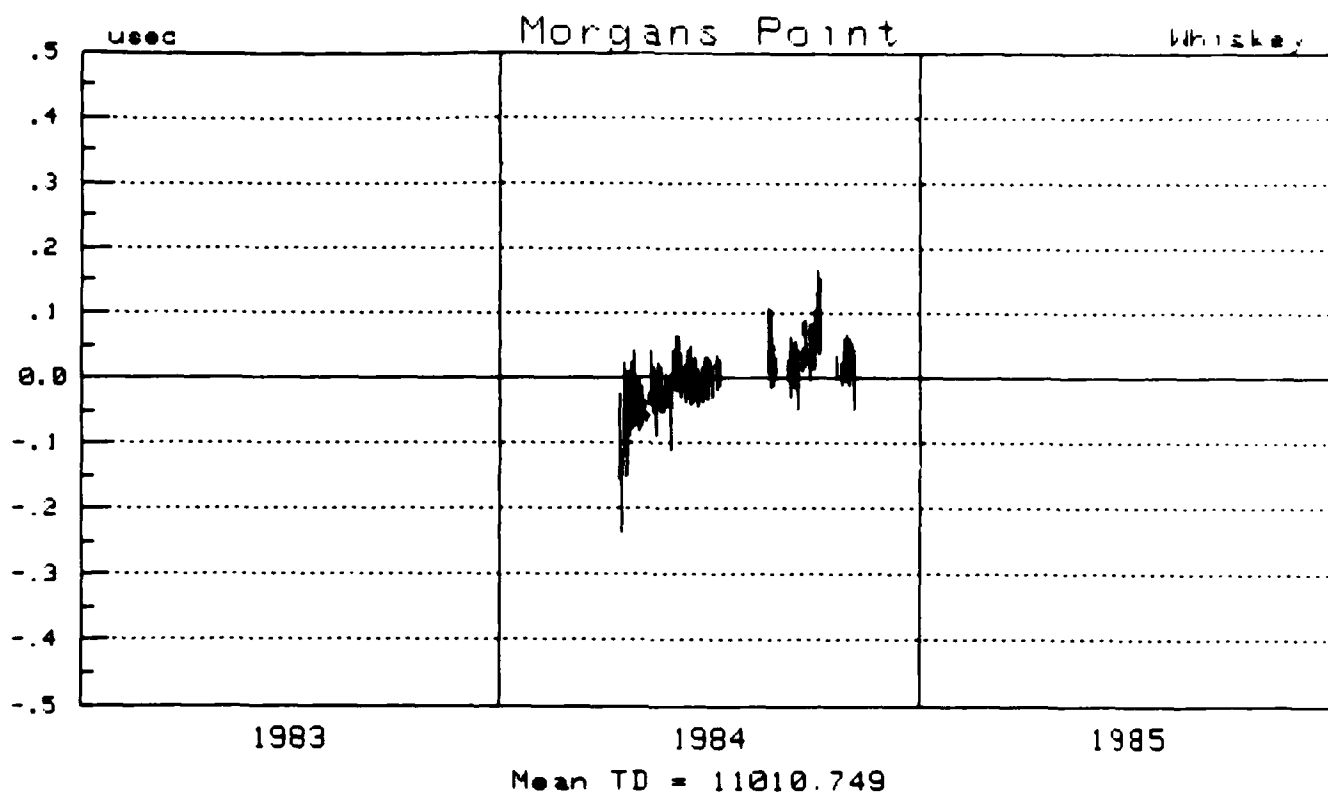
Receiving Antenna Location:

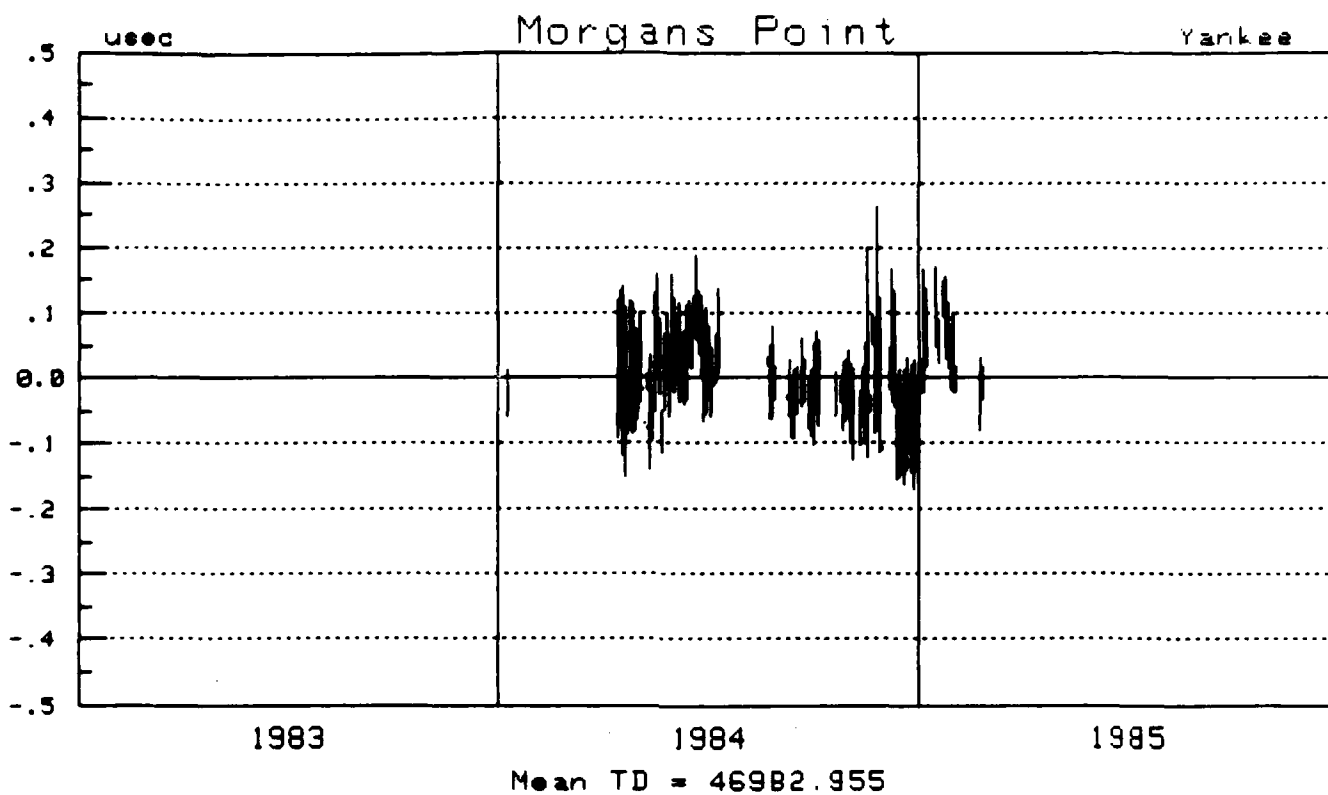
WGS 72
LAT : 29 40 9.8N
LON : 94 58 40.3W

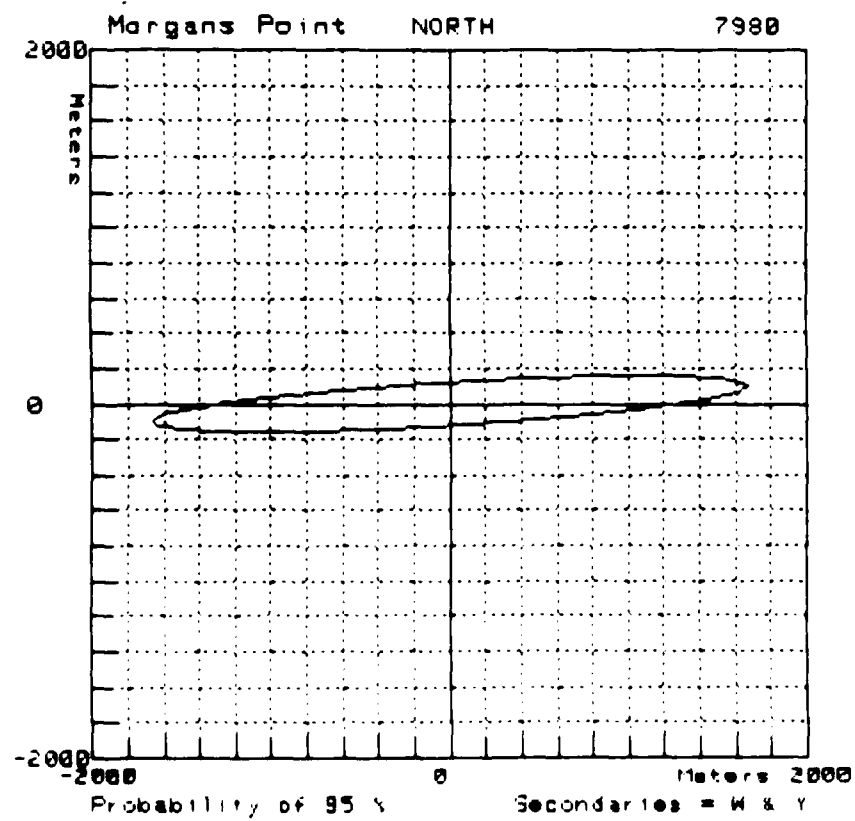
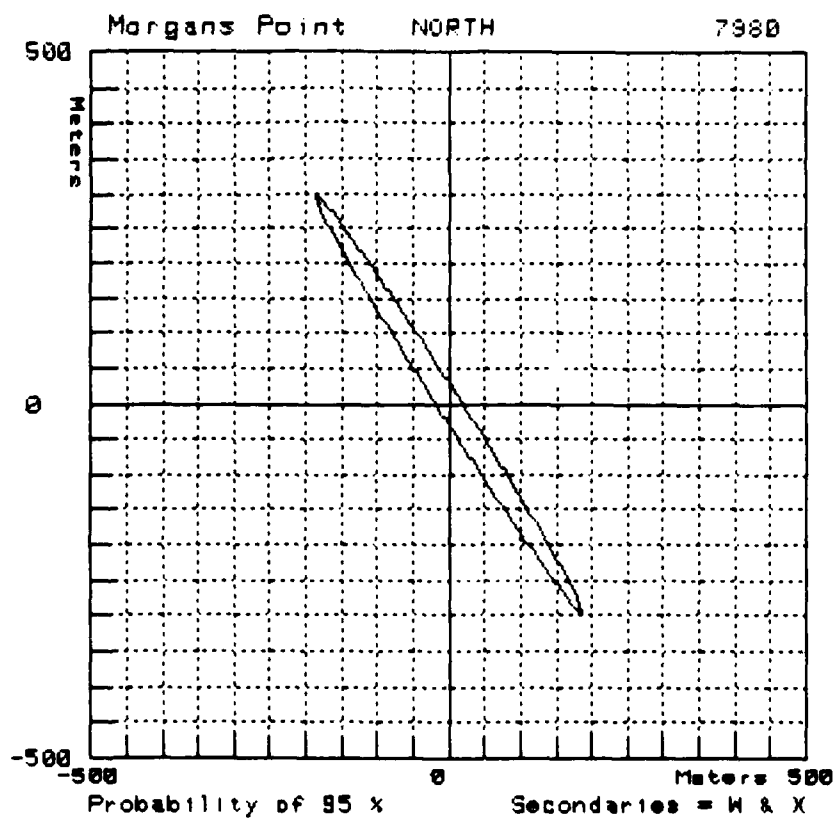
NAD 27
LAT : 29 40 9N
LON : 94 58 39W

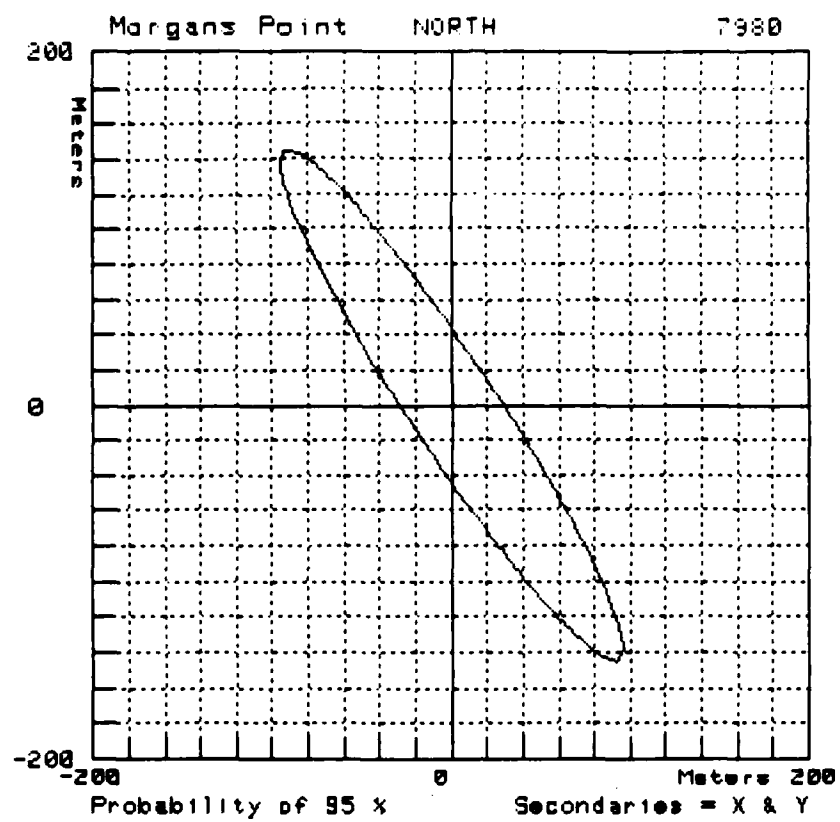
Positioning System
From Nautical Chart

W-LOP: 75.2 deg	Gradients: 9289 ft/usec
X-LOP: 149.0 deg	Gradients: 521 ft/usec
Y-LOP: 88.2 deg	Gradients: 2927 ft/usec









HMS SITE INFORMATION

NEW ORLEANS, LOUISIANA

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 01 January 1983 - 25 March 1985

GRI: 7980 U.S. Southeast Chain

TDW: 11612.459 A1 Control
TDX: 28656.707 A1 Control

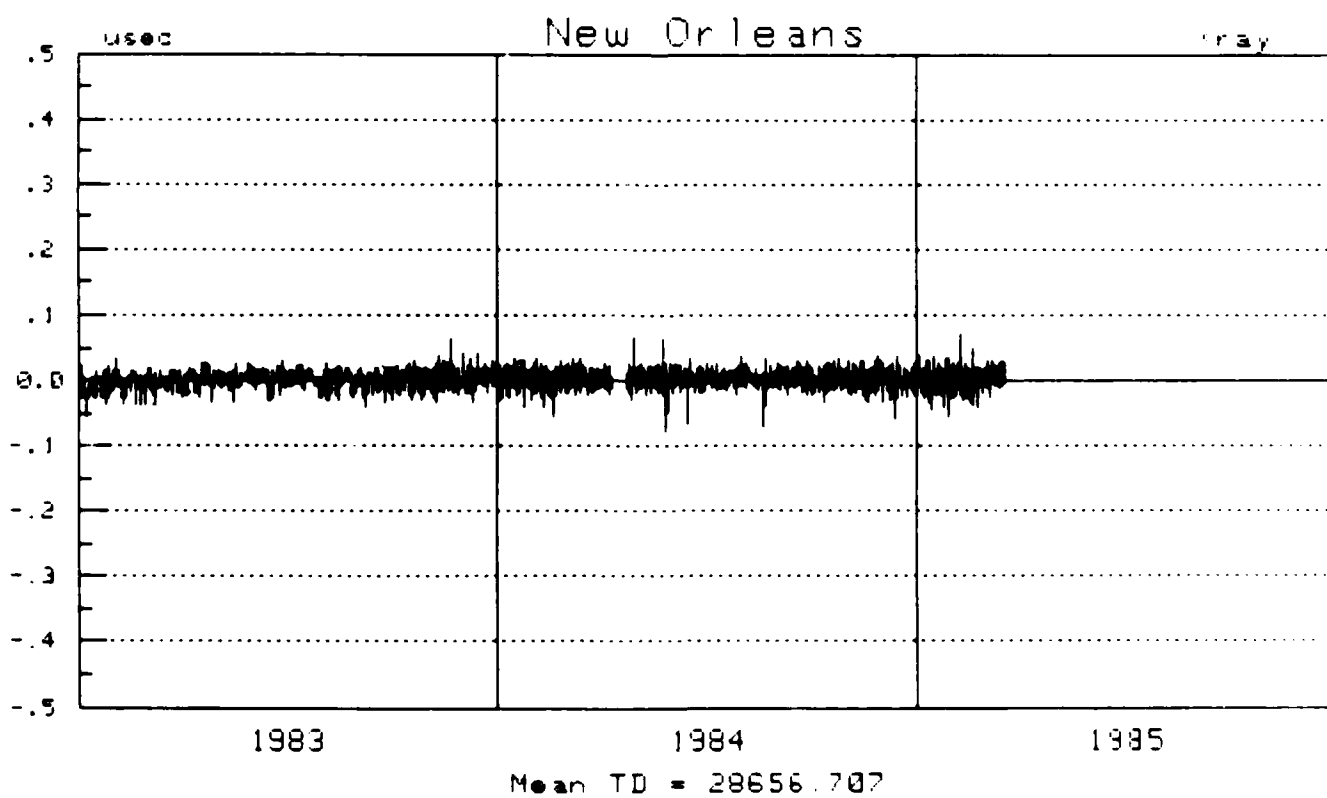
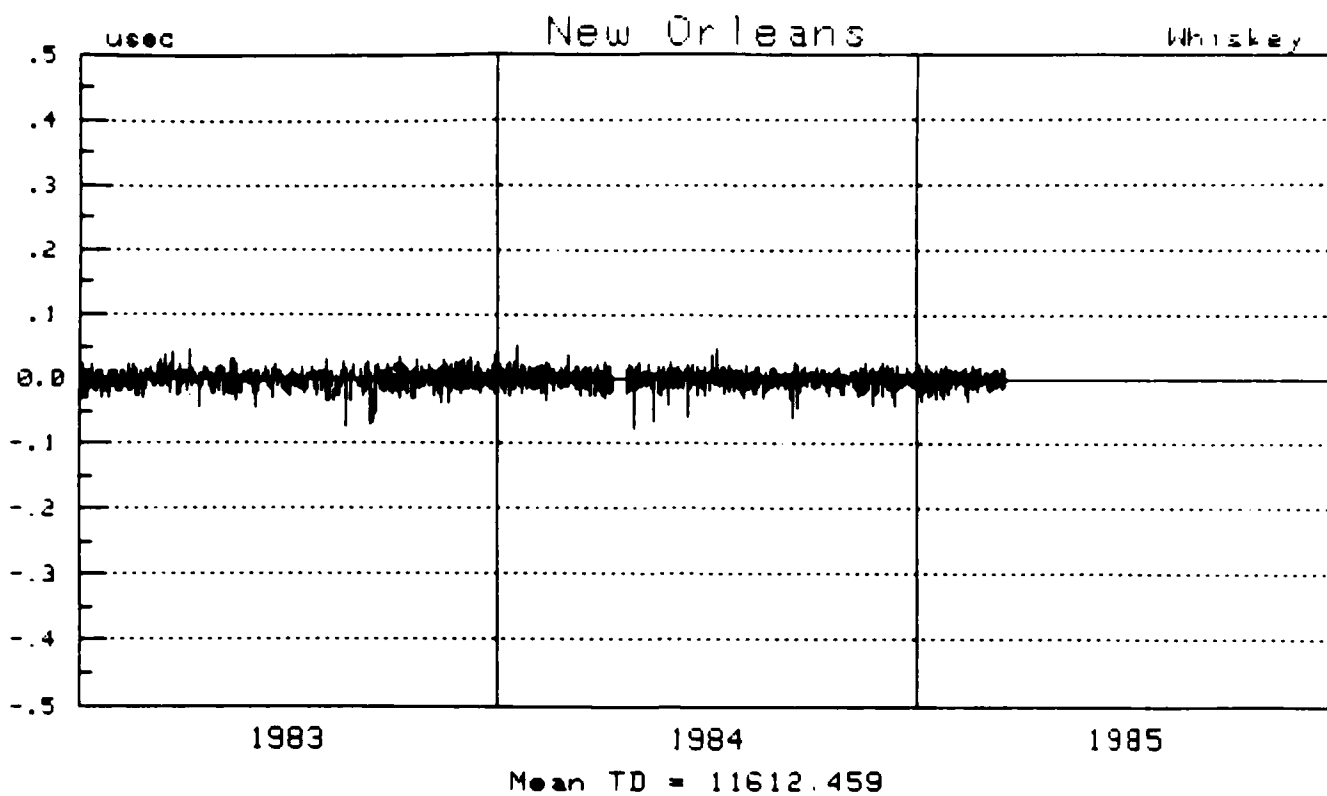
Receiving Antenna Location:

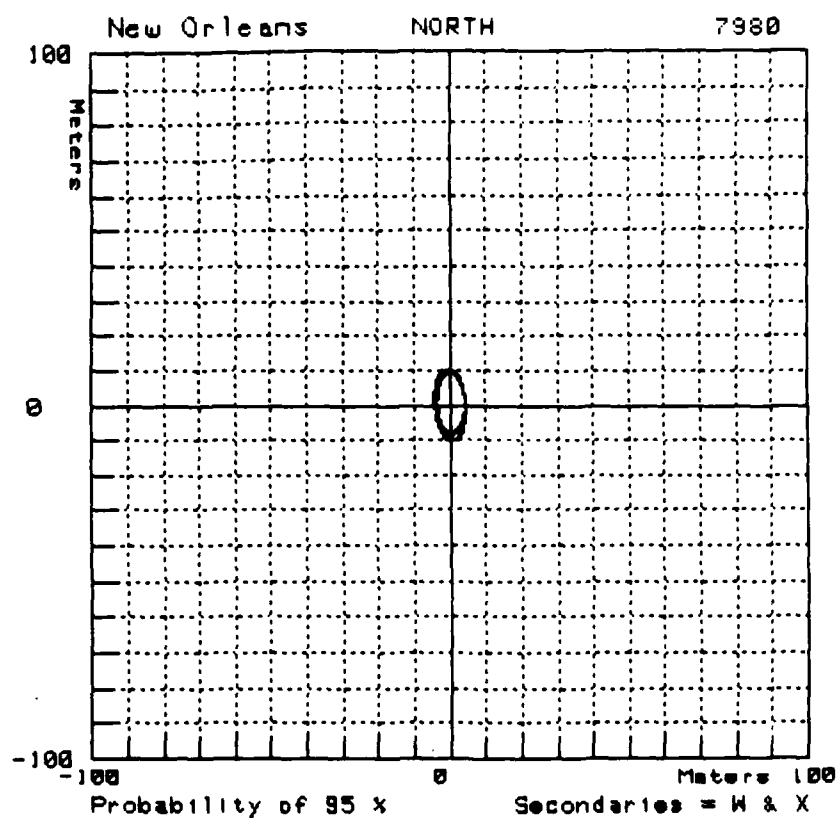
WGS 72
LAT : 29 49 17.3N
LON : 90 01 44.2W

NAD 27
LAT : 29 49 16.47N
LON : 90 01 43.38W

Positioning System
From G-NRN

W-LOP: 197.9 deg Gradients: 598 ft/usec
X-LOP: 159.8 deg Gradients: 492 ft/usec





HMS SITE INFORMATION

PORT ARANSAS, TEXAS

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 14 May 1983 - 23 April 1985

GRI: 7980 U.S. Southeast Chain

TDW: 11070.753
TDX: 23966.483
TDY: 46774.343

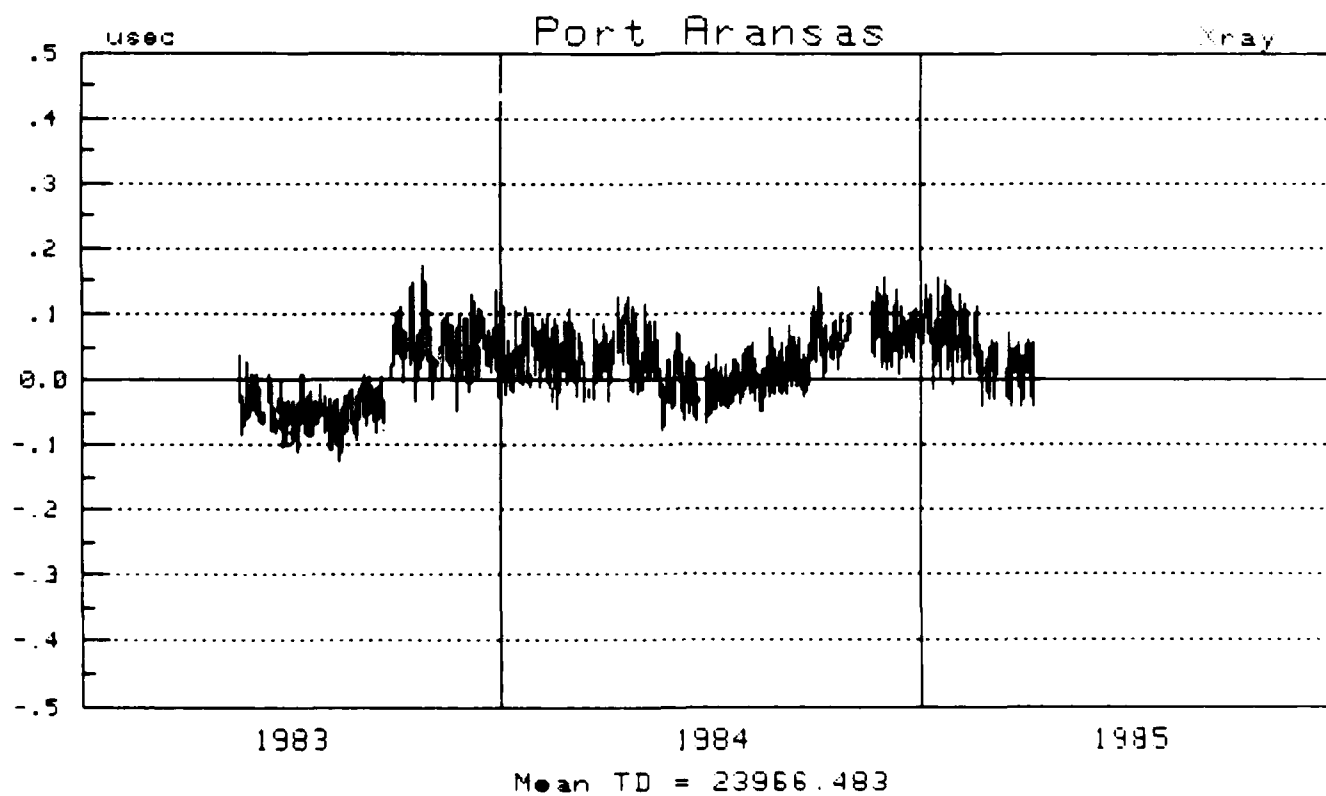
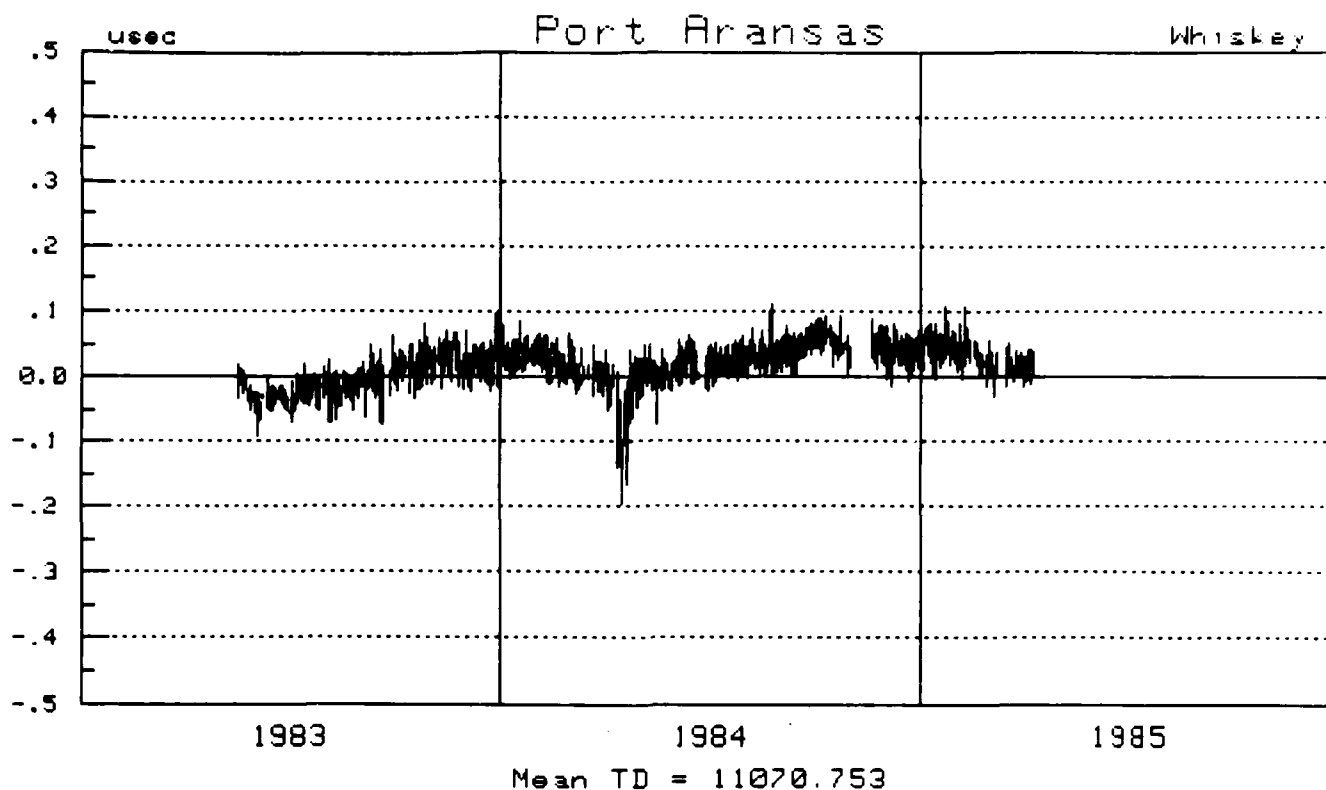
Receiving Antenna Location:

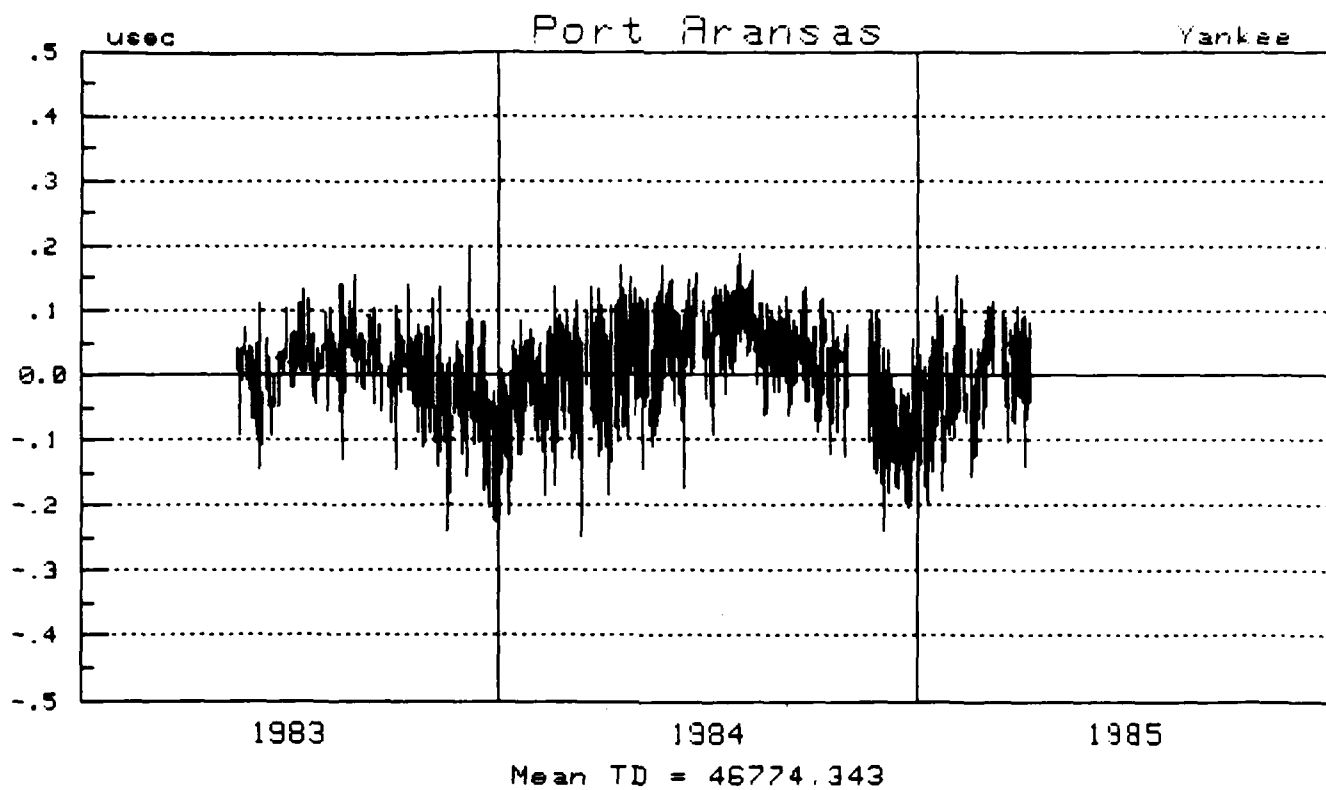
WGS 72
LAT : 27 50 23.22N
LON : 97 03 31.9 W

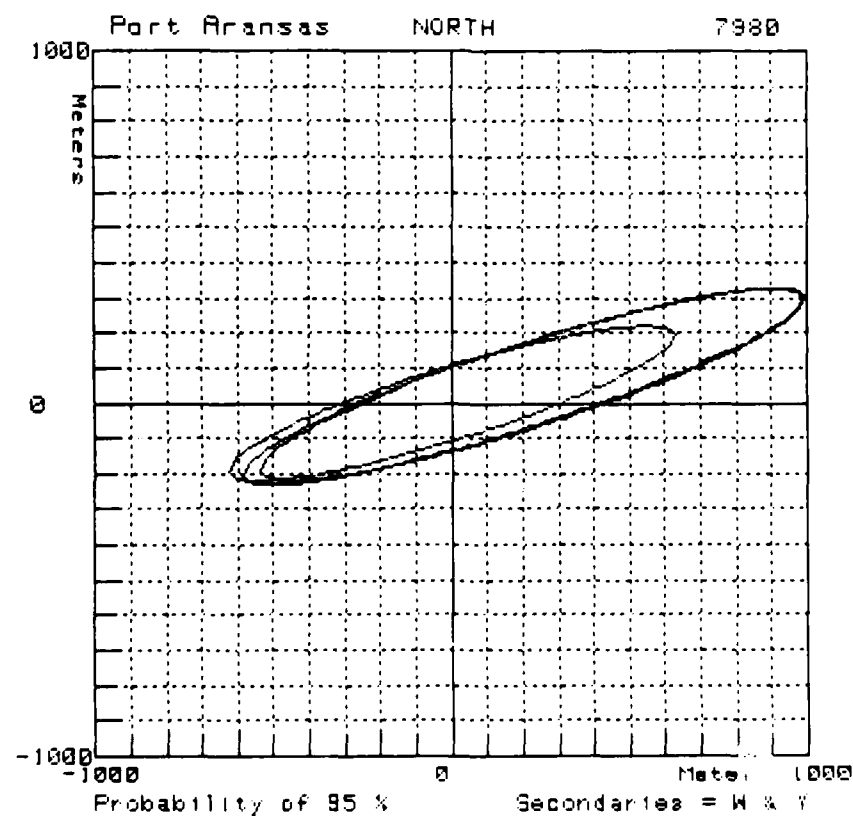
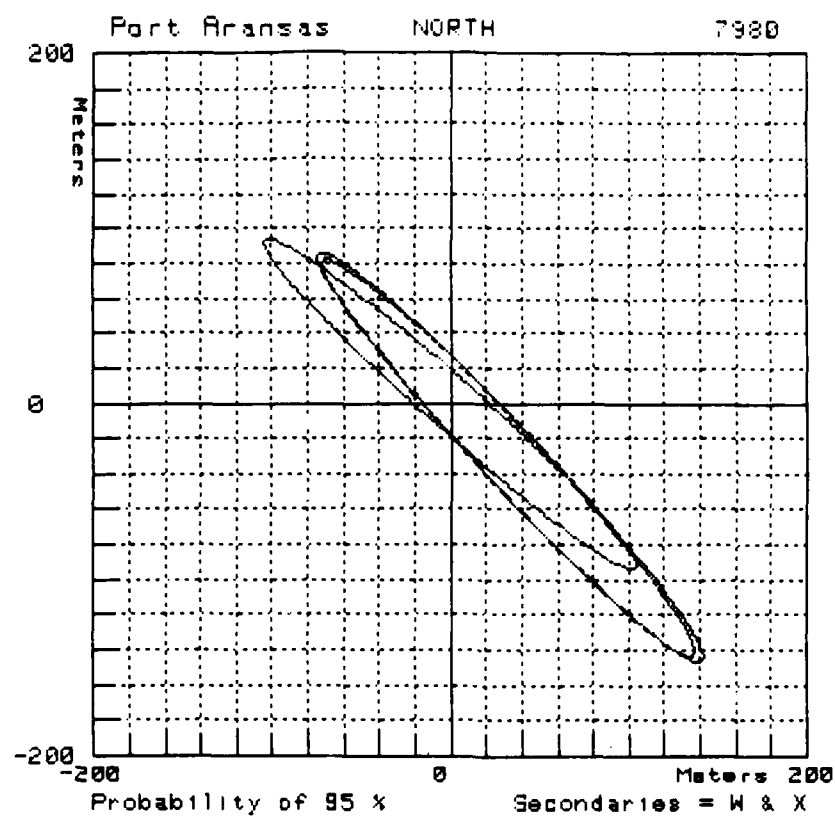
NAD 27
LAT : 27 50 22.22N
LON : 97 03 30.40W

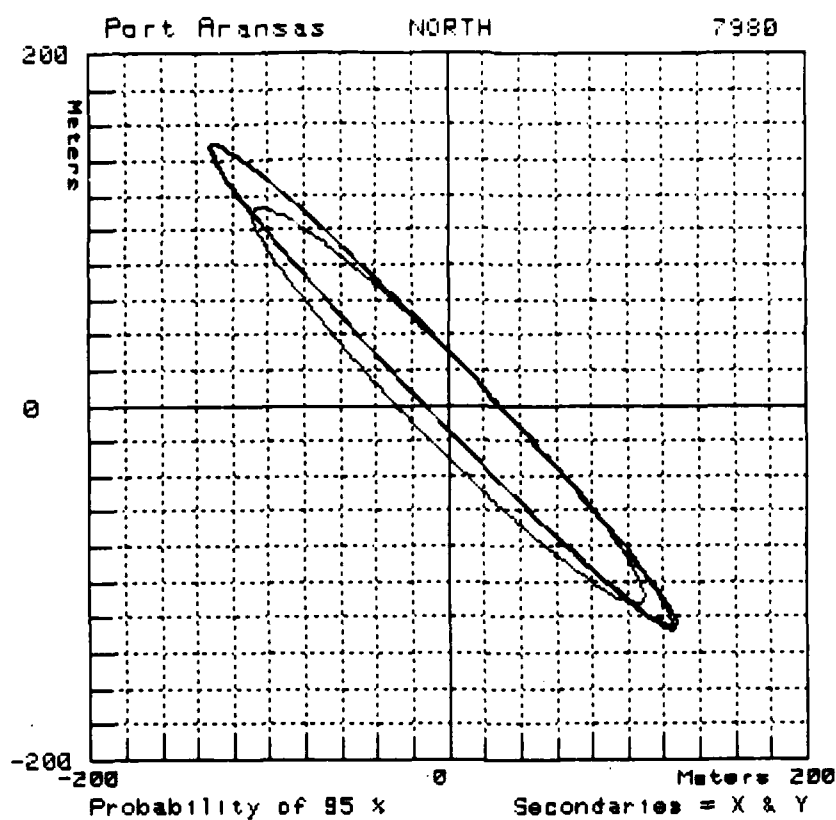
Positioning System
GPS

W-LOP: 65.4 deg	Gradients: 5862 ft/usec
X-LOP: 139.0 deg	Gradients: 527 ft/usec
Y-LOP: 79.7 deg	Gradients: 3005 ft/usec









HMS SITE INFORMATION

PORT ISABEL, TEXAS

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 3 April 1984 - 21 April 1985

GRI: 7980 U.S. Southeast Chain

TDW: 11184.017
TDX: 23403.482
TDY: 46561.823

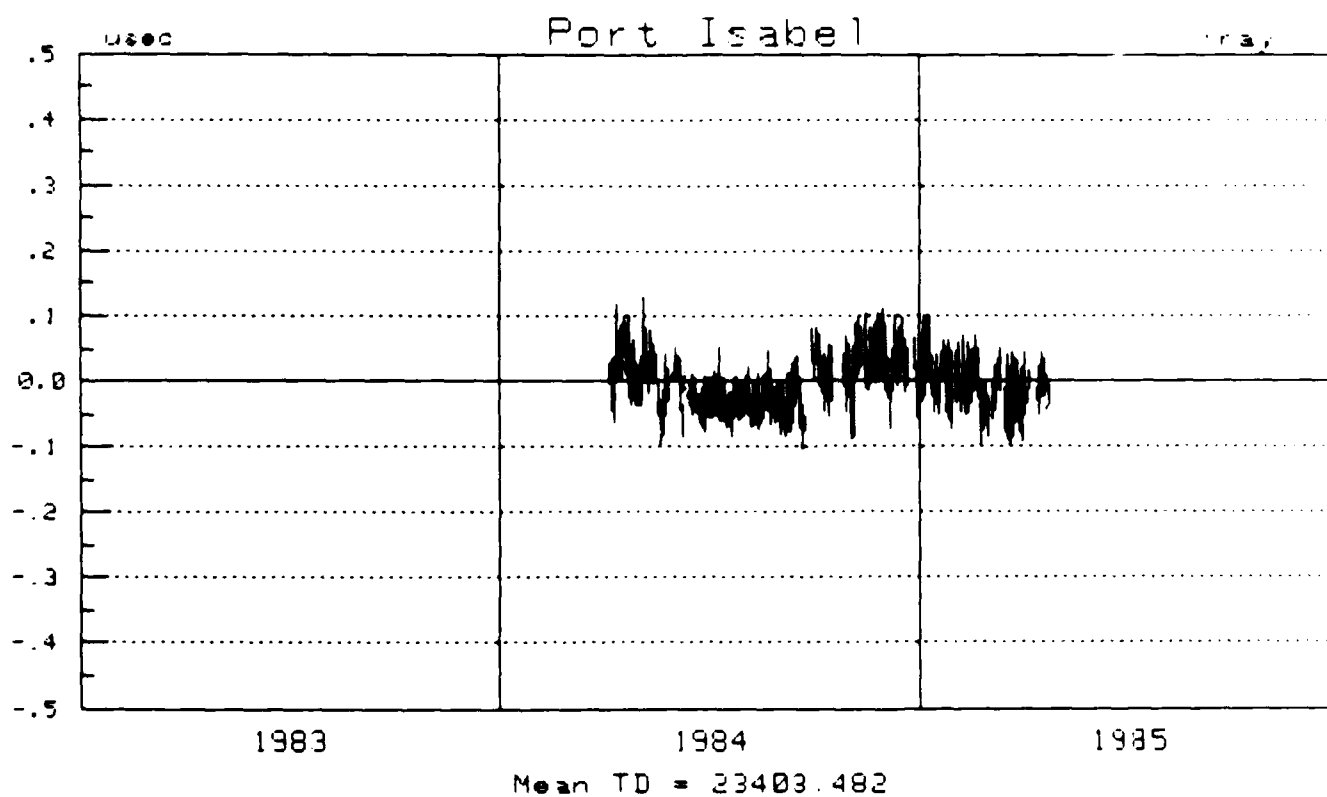
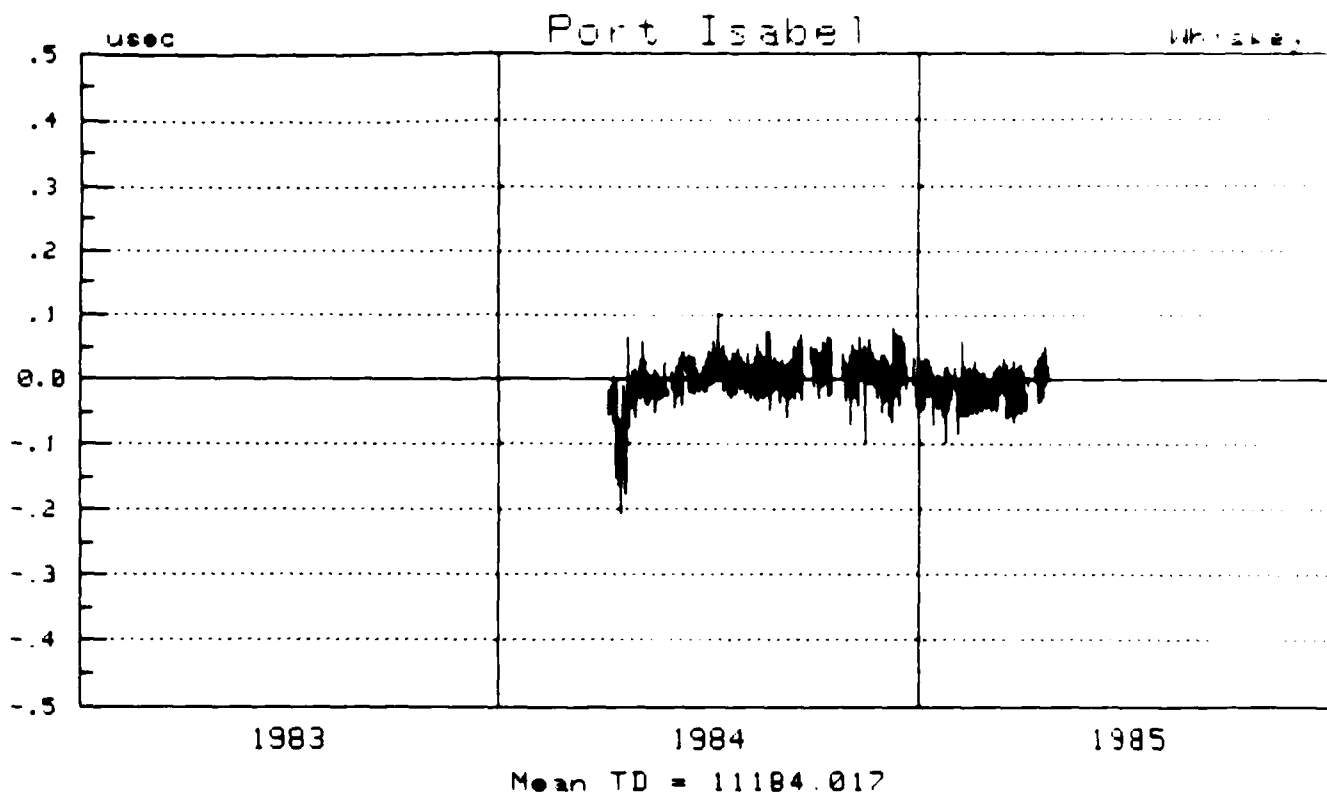
Receiving Antenna Location:

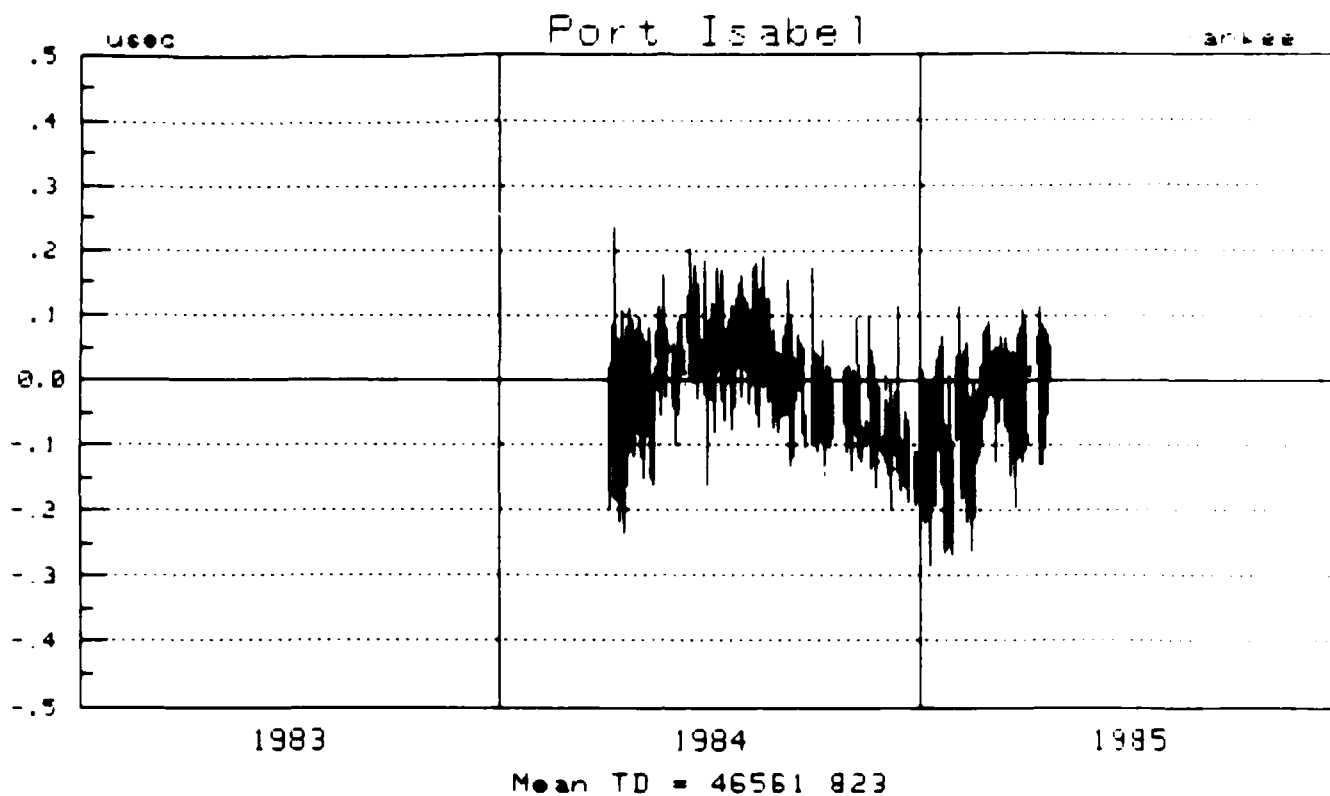
WGS 72
LAT : 26 04 22.64N
LON : 97 09 58.49W

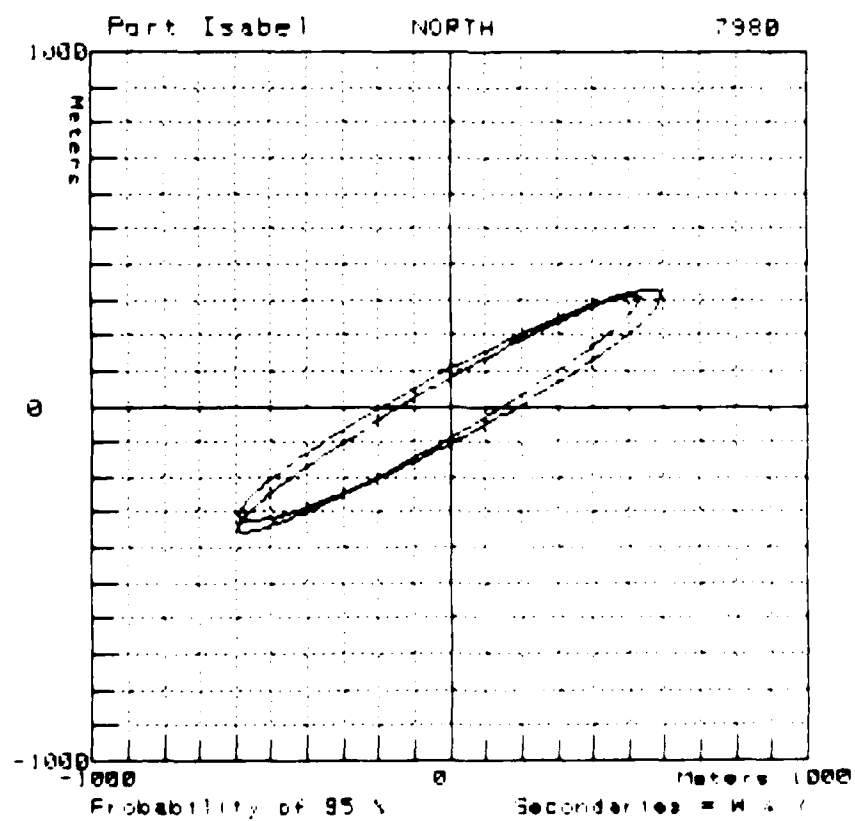
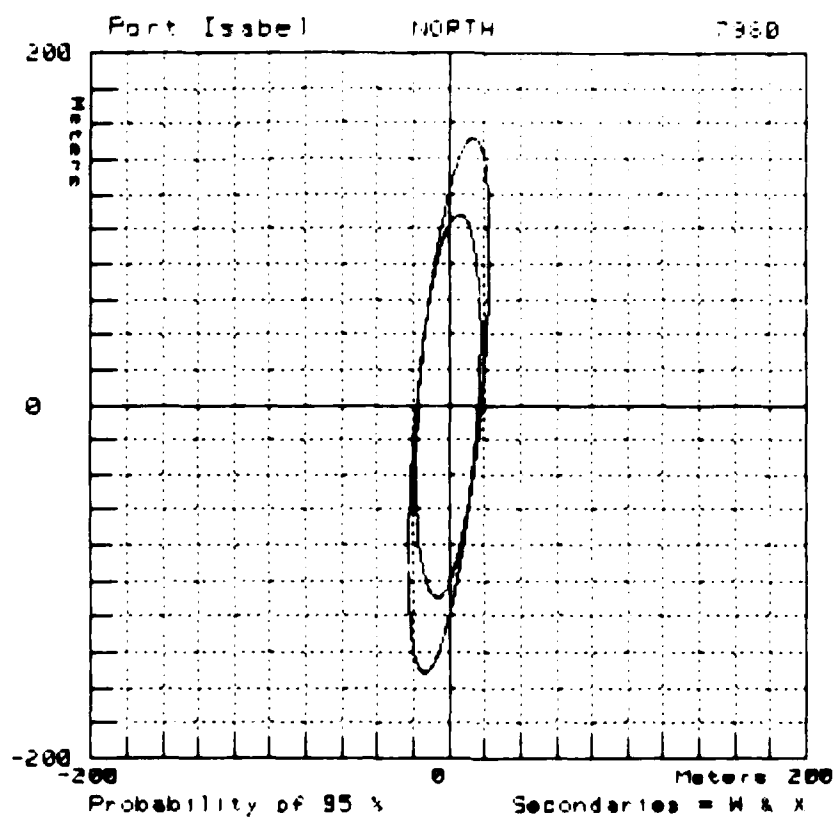
NAD 27
LAT : 26 04 21.41N
LON : 97 09 57.00W

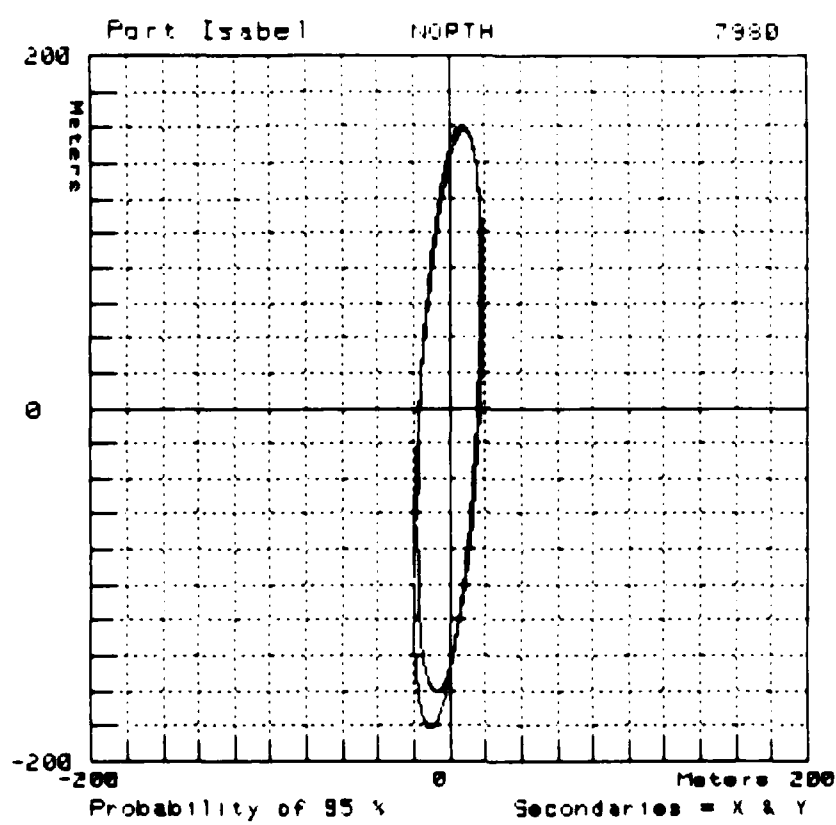
Positioning System
GPS

W-LOP: 55.4 deg	Gradients: 4187 ft/usec
X-LOP: 4.9 deg	Gradients: 583 ft/usec
Y-LOP: 72.4 deg	Gradients: 2786 ft/usec









HMS SITE INFORMATION

ST. PETERSBURG, FLORIDA

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 27 April 1982 - 1 March 1986

GRI: 7980 U.S. Southeast Chain

TDW: 14234.782
TDY: 44621.685
TDZ: 62864.666

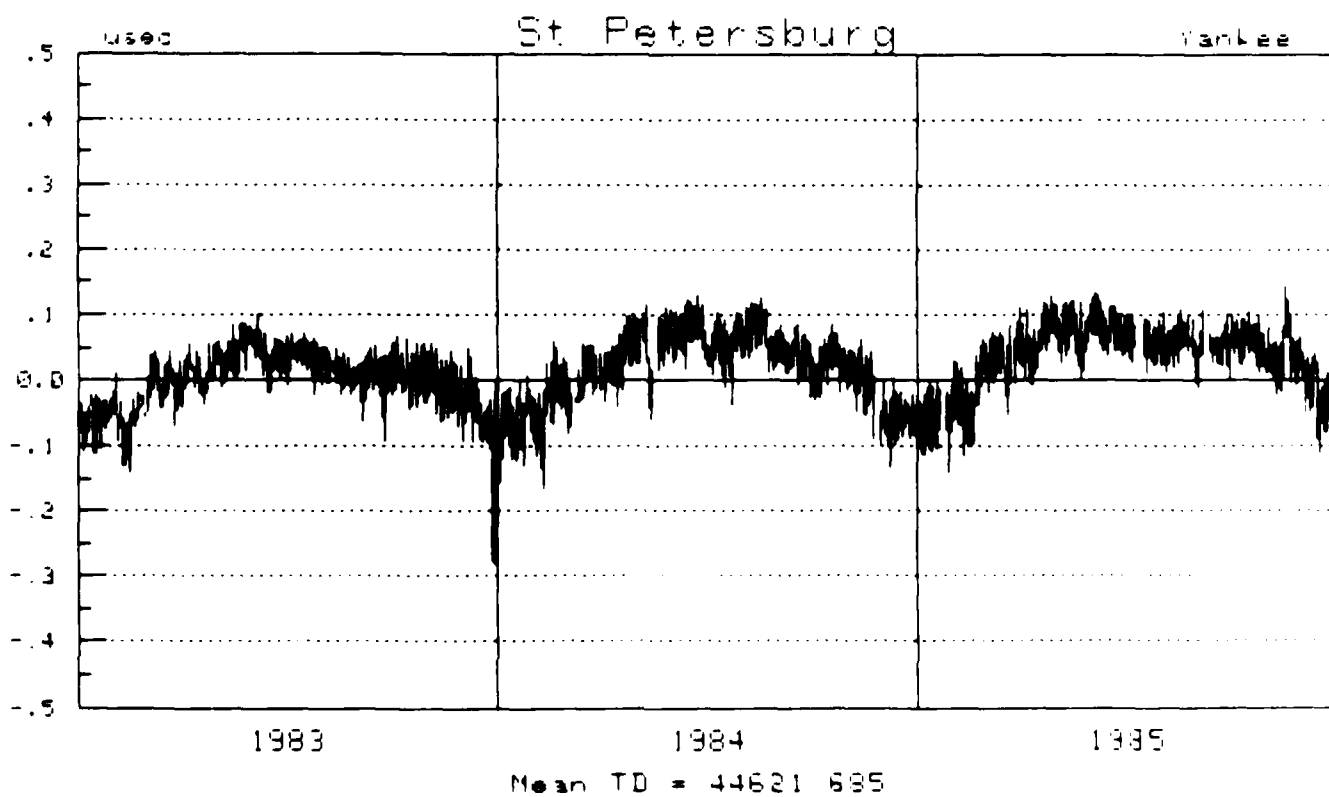
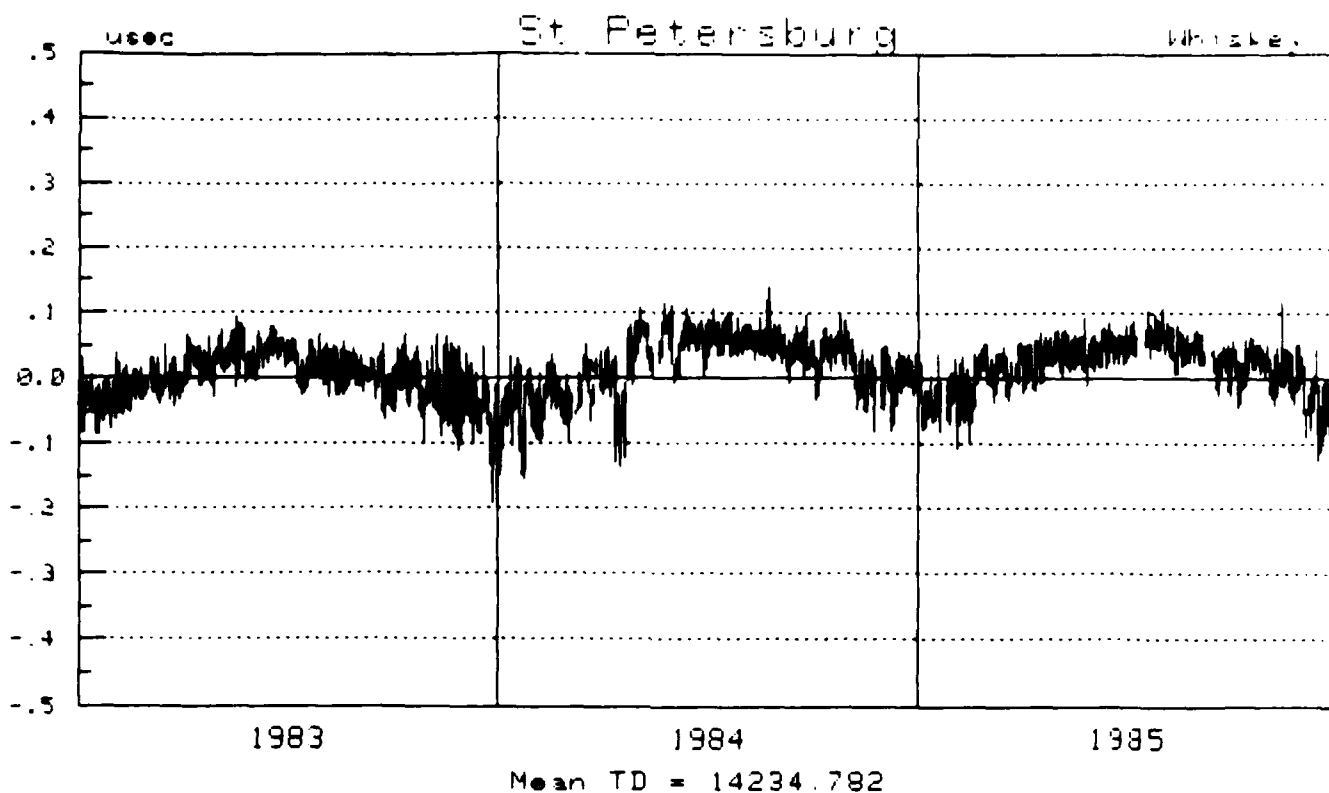
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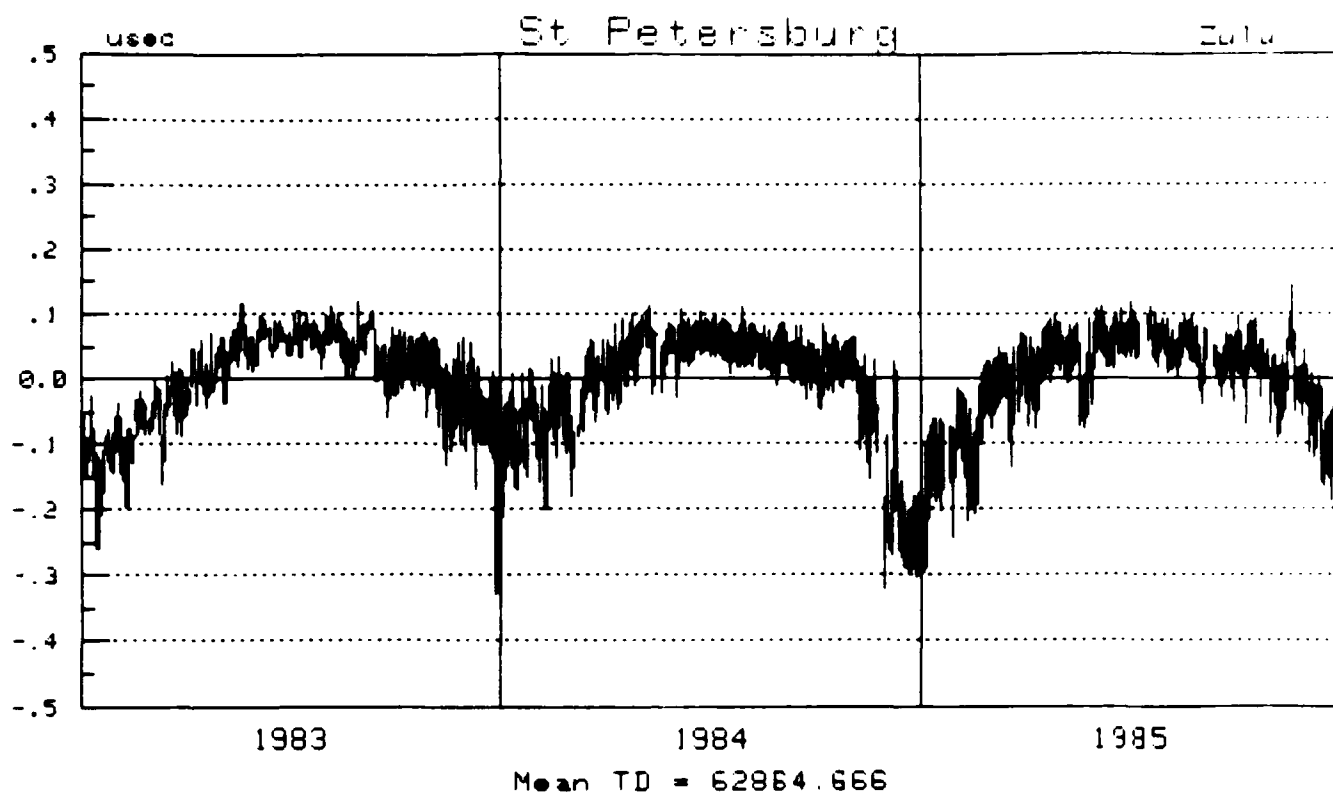
WGS 72
LAT : 27 45 41.51N
LON : 82 37 38.2 W

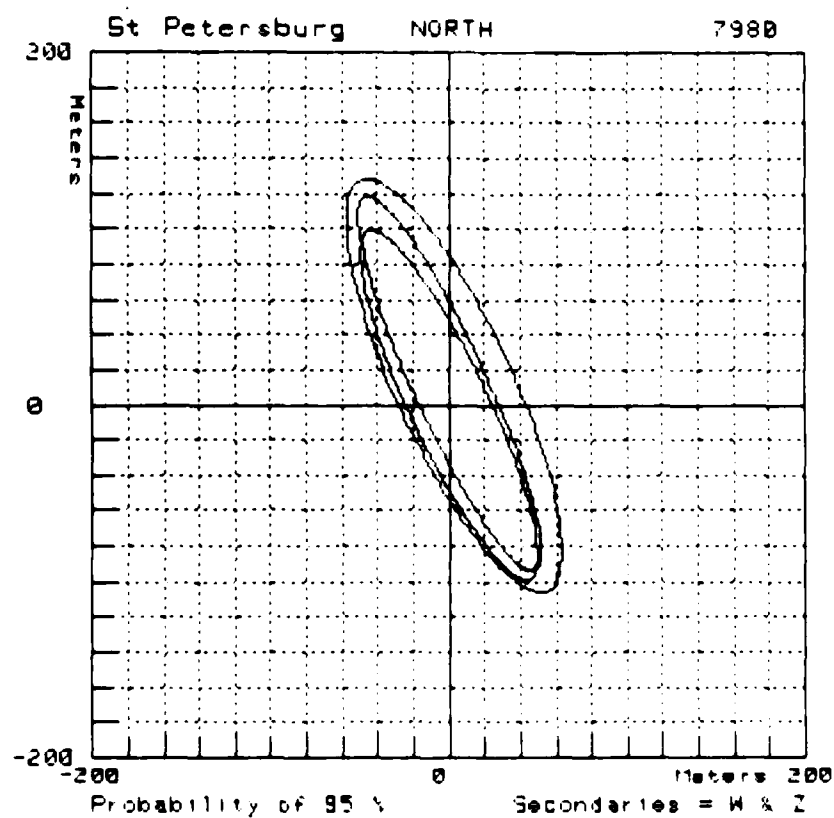
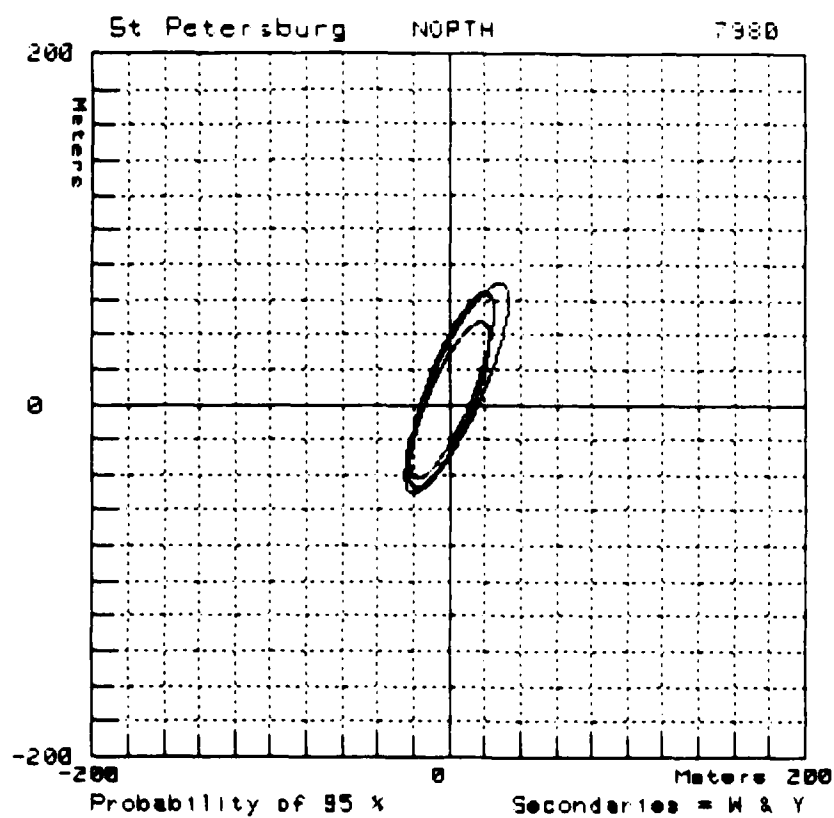
NAD 27
LAT : 27 45 40.42N
LON : 82 37 38.14W

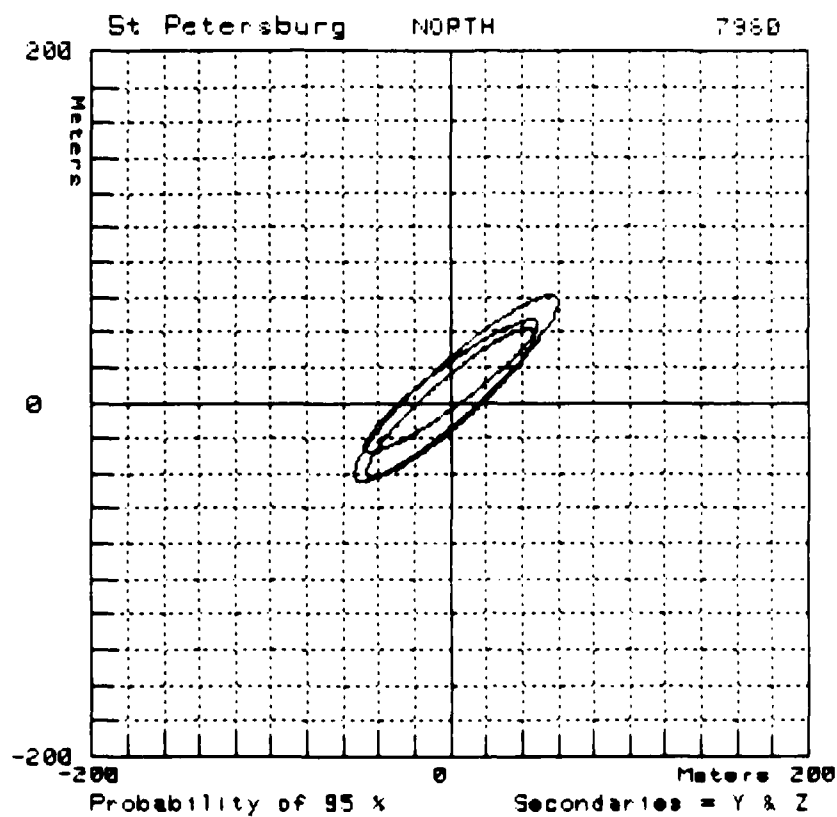
Positioning System
GPS

W-LOP: 310.3 deg	Gradients: 1800 ft/usec
Y-LOP: 216.8 deg	Gradients: 521 ft/usec
Z-LOP: 178.9 deg	Gradients: 908 ft/usec









HMS SITE INFORMATION

BAYFIELD, WISCONSIN

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 26 August 1985 - Present

GRI: 8970 U.S. Great Lakes Chain

TDX: 32422.066
TDY: 46171.321

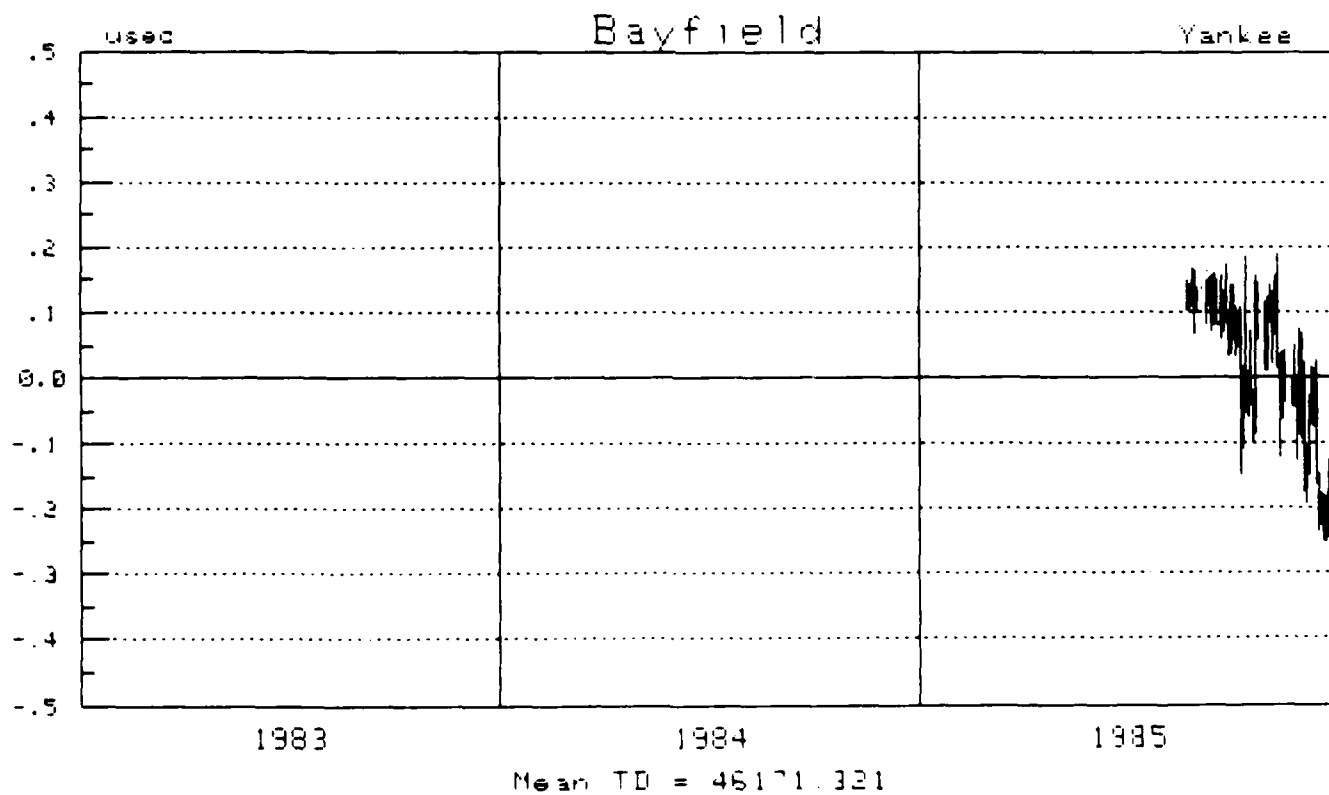
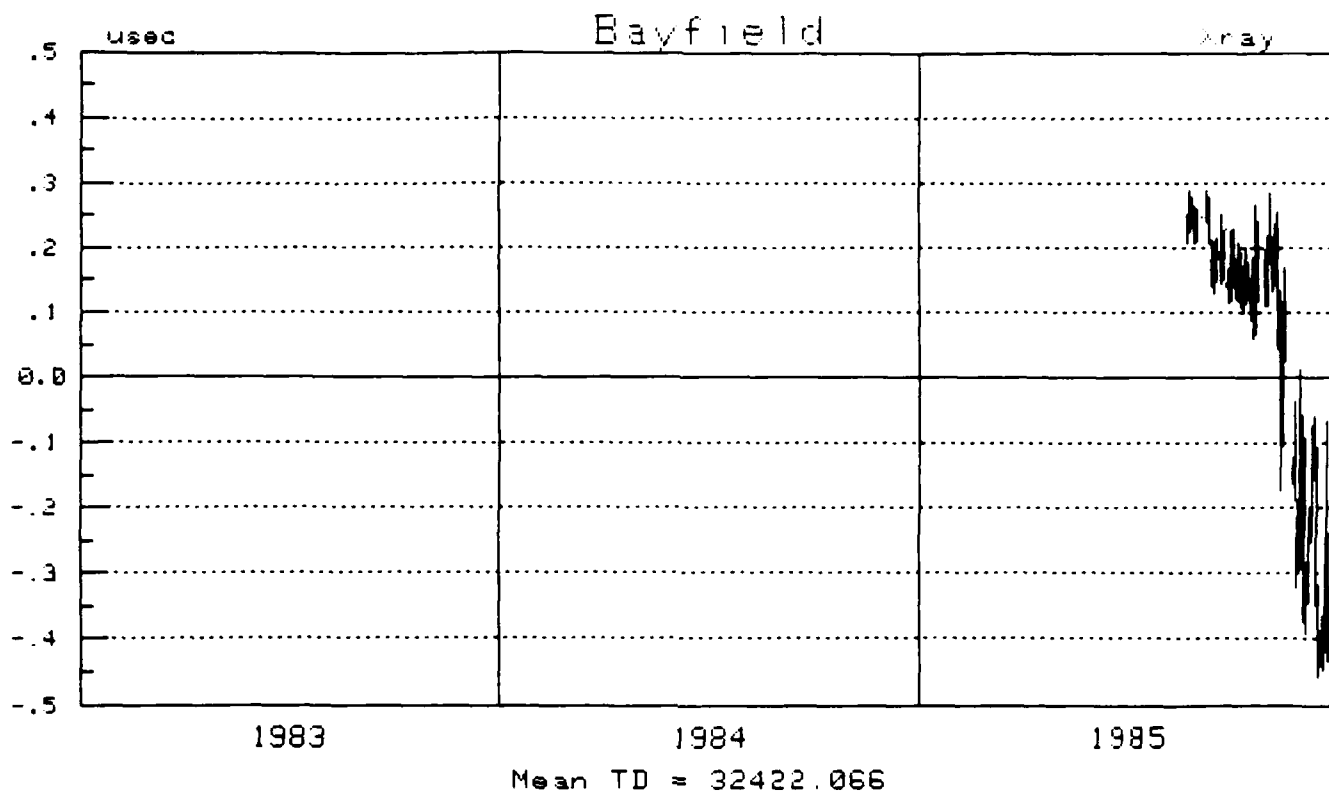
Receiving Antenna Location:

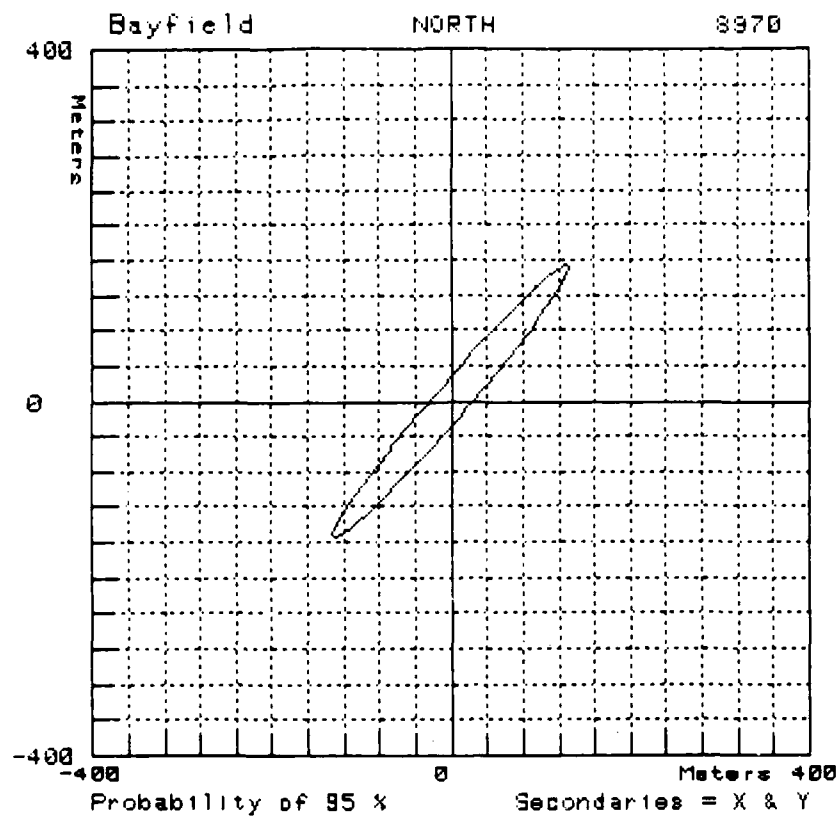
WGS 72
LAT : 46 48 27.9 N
LON : 90 49 08.49W

NAD 27
LAT : 46 48 27.99N
LON : 90 49 07.35W

Positioning System
GPS

X-LOP: 133.4 deg Gradients: 115.6 ft/usec
Y-LOP: 233.3 deg Gradients: 512.2 ft/usec





HMS SITE INFORMATION

BUFFALO, NEW YORK

Monitor: Type - D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 20 October 1982 - 01 January 1984

GRI: 8970 U.S. Northeast Chain

TDX: 29078.996
TDY: 49688.550

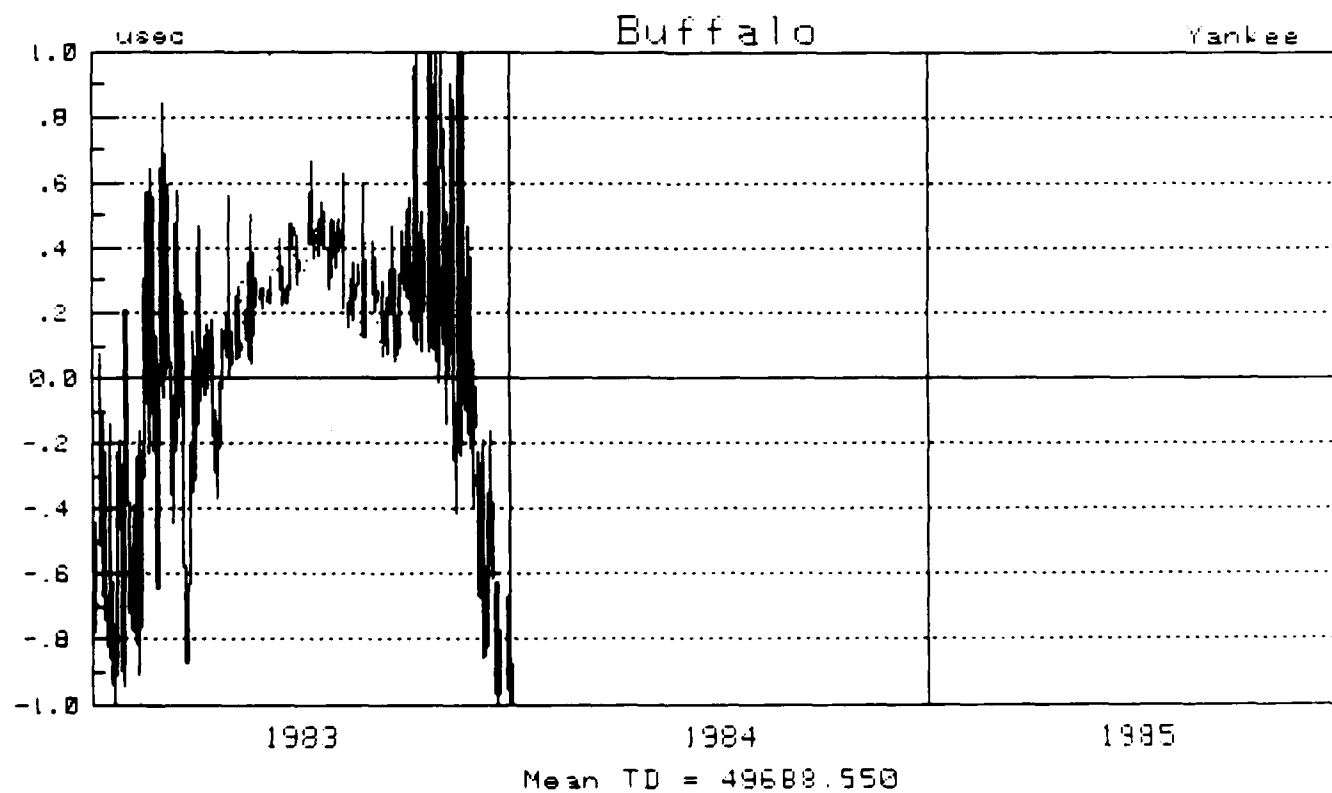
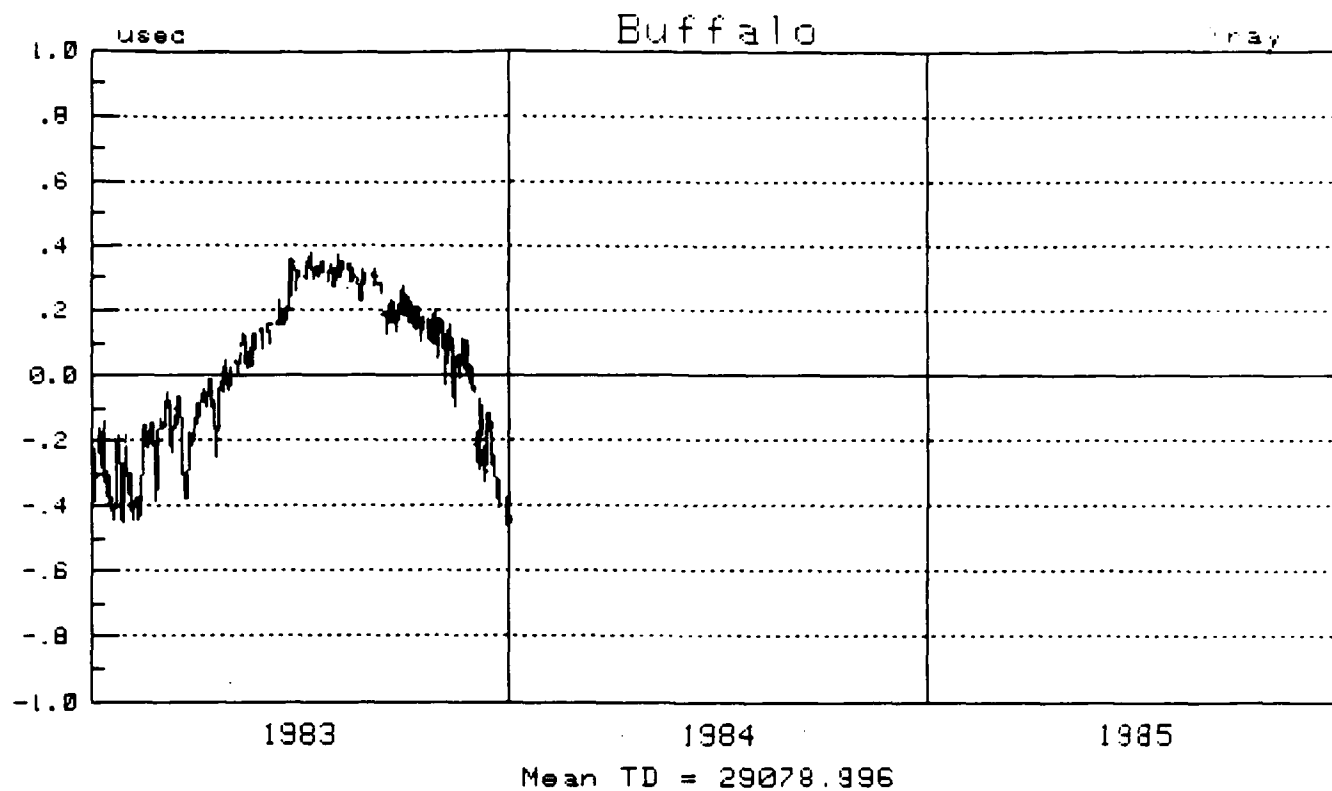
Receiving Antenna Location:

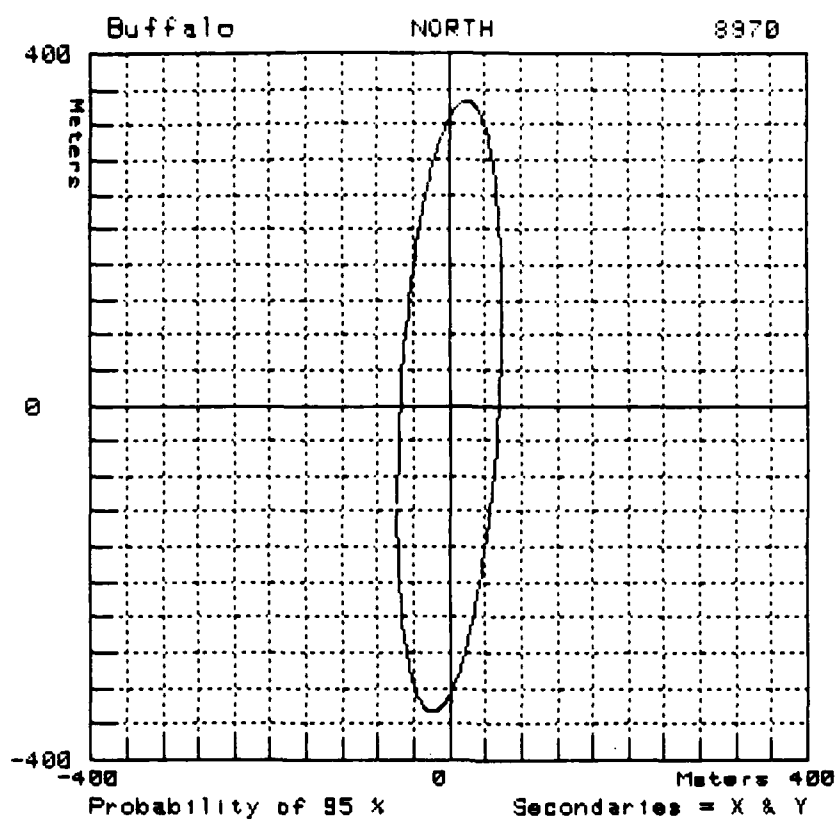
WGS 72
LAT : 42 52 49.9N
LON : 78 53 9.6W

NAD 27
LAT : 42 52 50.0N
LON : 78 53 10.0W

Positioning System
From Nautical Chart

W-LOP: 171.7 deg Gradients: 506 ft/usec
Y-LOP: 275.5 deg Gradients: 1061 ft/usec





HMS SITE INFORMATION

DESTIN, FLORIDA

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 01 September 1980 - May 1984

GRI: 8970 Great Lakes Chain

TDW: 11328.849 A2

Receiving Antenna Location:

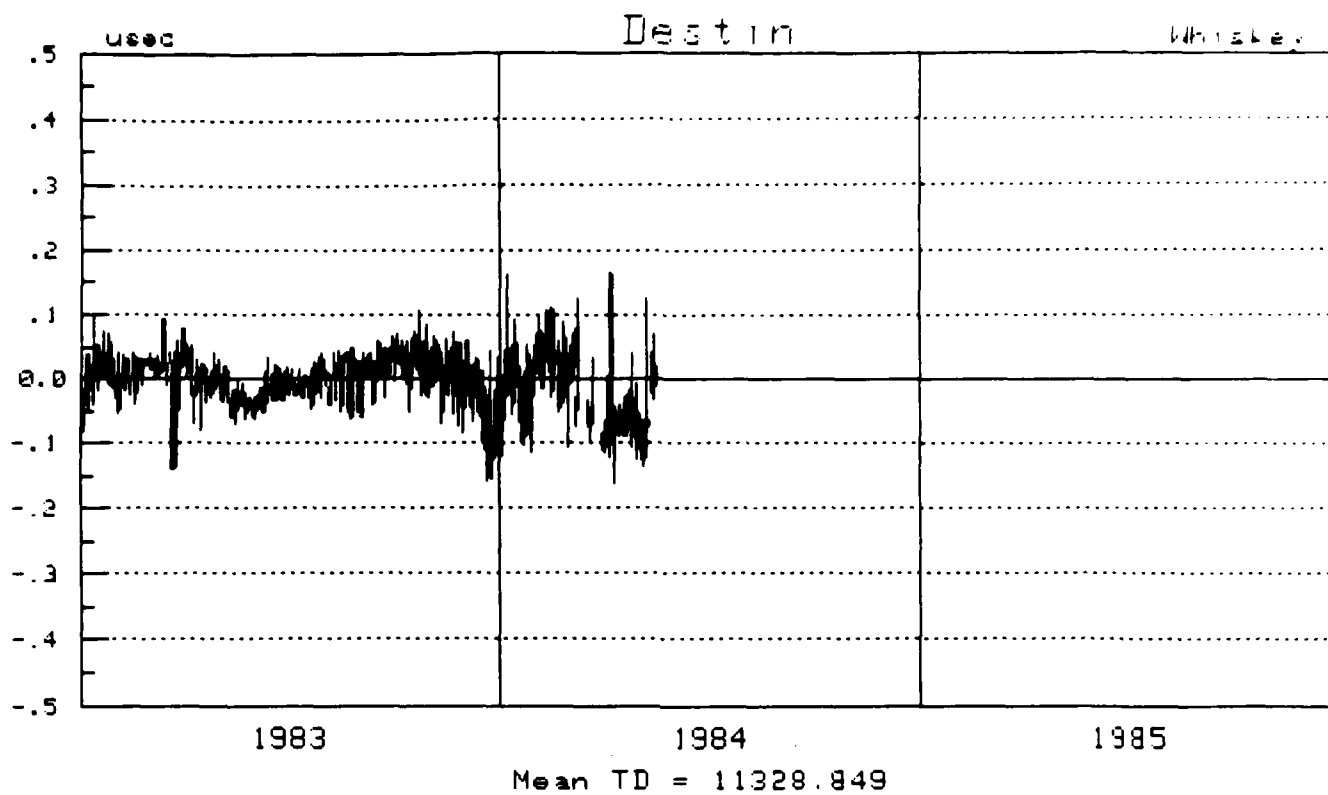
WGS 72
LAT : 30 23 35.54N
LON : 86 32 18.99W

NAD 27
LAT : 30 23 34.75N
LON : 86 32 18.52W

Positioning System
GPS

W-LOP: 209.1 deg

Gradients: 888.8 ft/usec



HMS SITE INFORMATION

DULUTH, MINNESOTA

Monitor: Type-C
Monitor Equipment: LC-404 and PCM-12
Data Collection: 28 May 1982 - December 1983

GRI: 8970 Great Lakes Chain

TDX: 32610.444
TDY: 45821.243

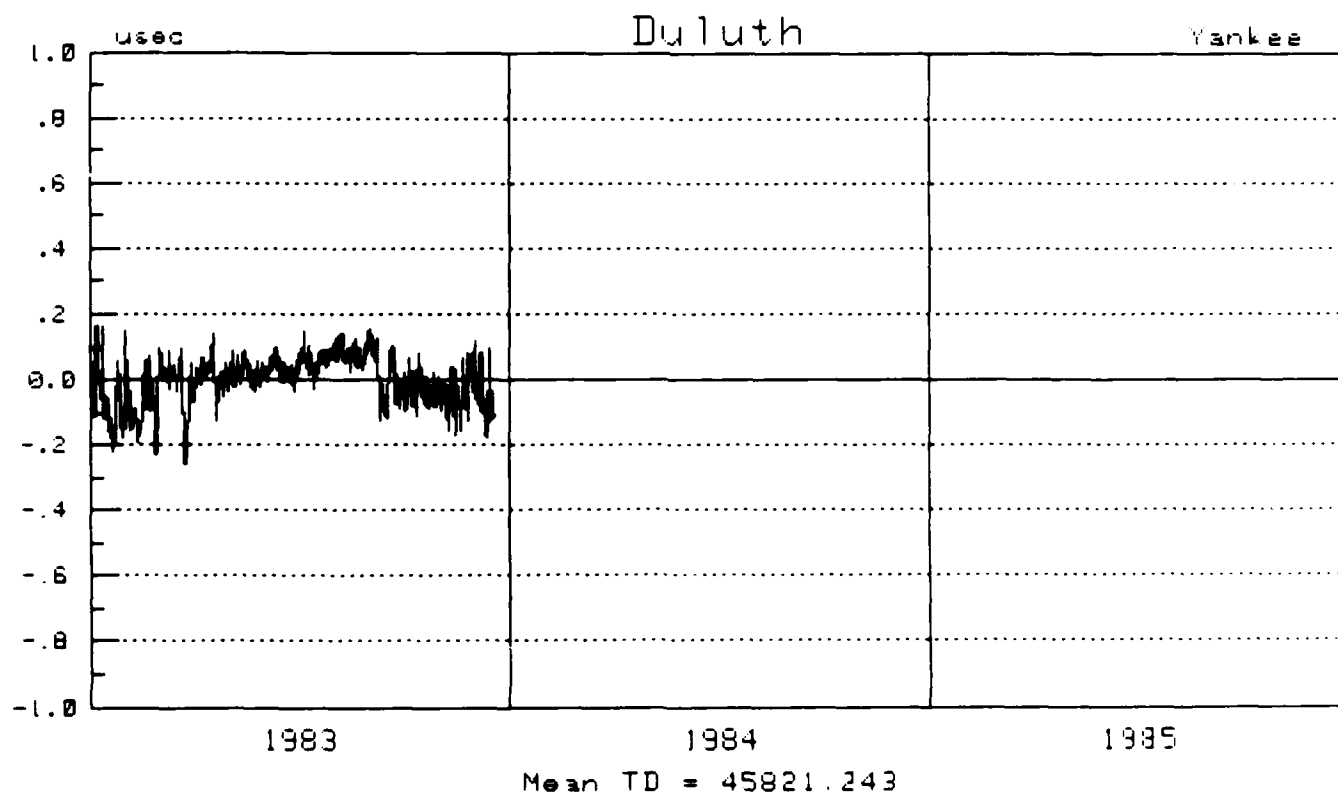
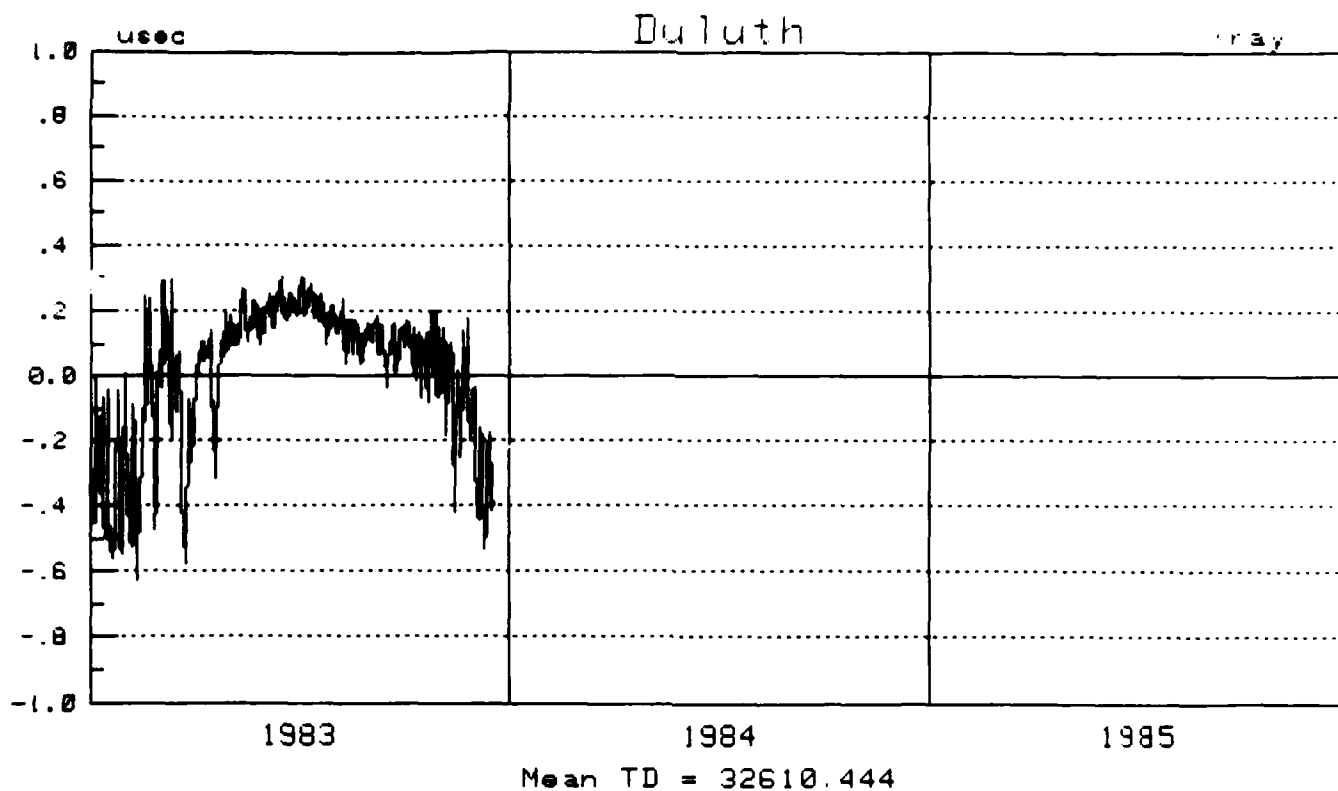
Receiving Antenna Location:

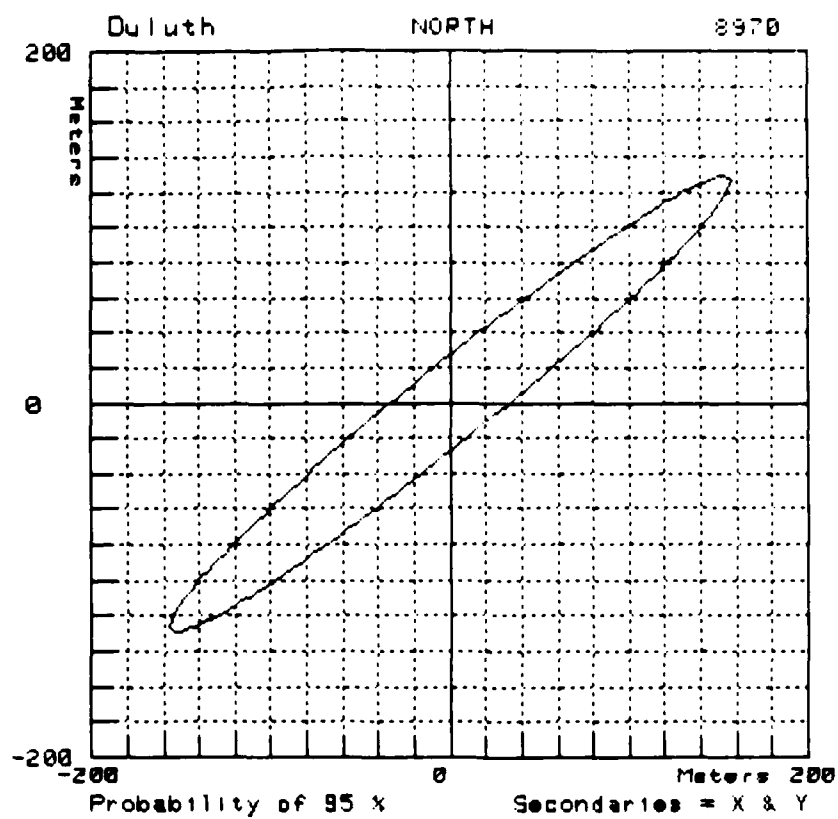
WGS 72
LAT : 46 46 18.02N
LON : 92 5 25.38W

NAD 27
LAT : 46 46 18.13N
LON : 92 5 24.08W

Positioning System
GPS

X-LOP: 128.8 deg Gradients: 1220 ft/usec
Y-LOP: 235.7 deg Gradients: 495 ft/usec





HMS SITE INFORMATION

DUNBAR FOREST, MICHIGAN

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 14 March 1983 - 24 May 1984
and 25 September 1985 - Present

GRI: 8970 Great Lakes Chain

TDX: 30978.799 A1 Control
TDY: 47929.620 A1 Control

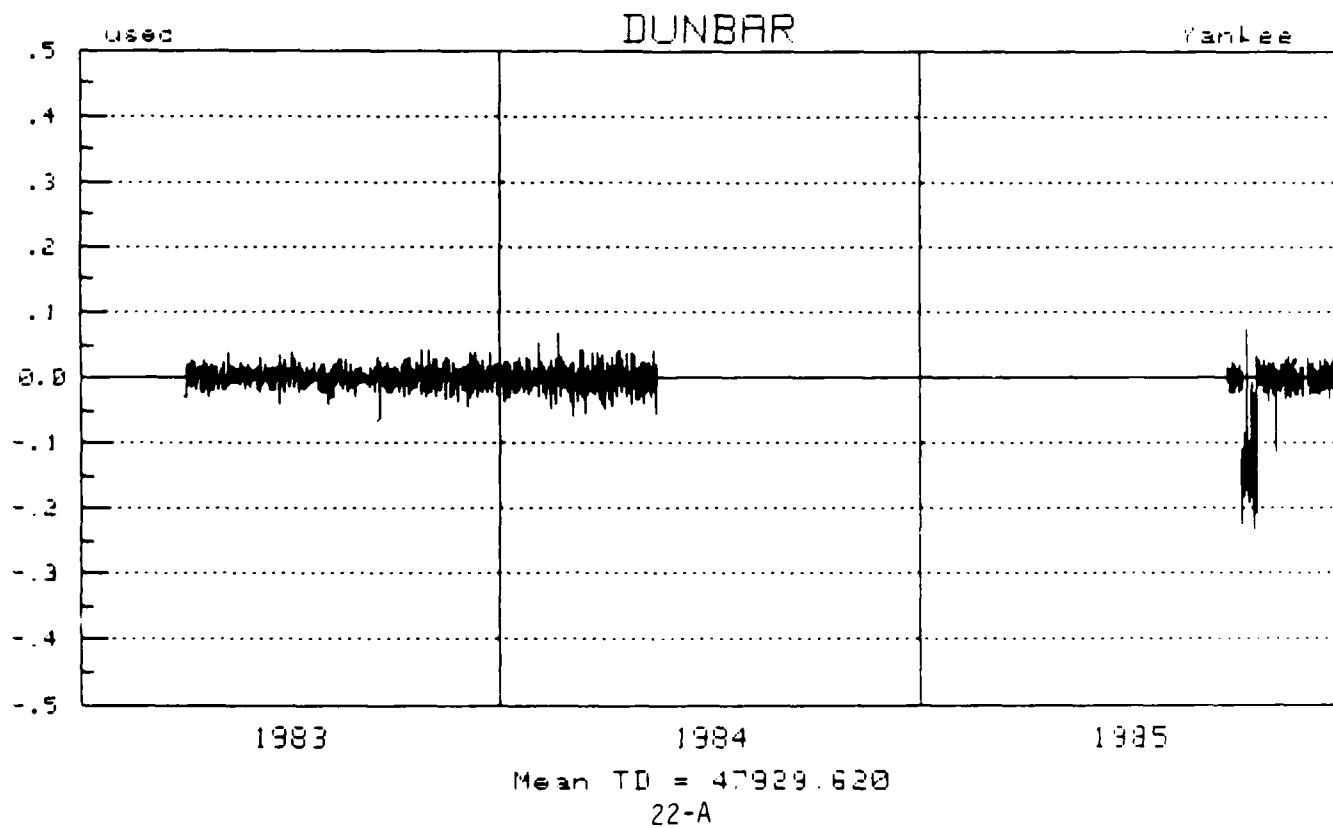
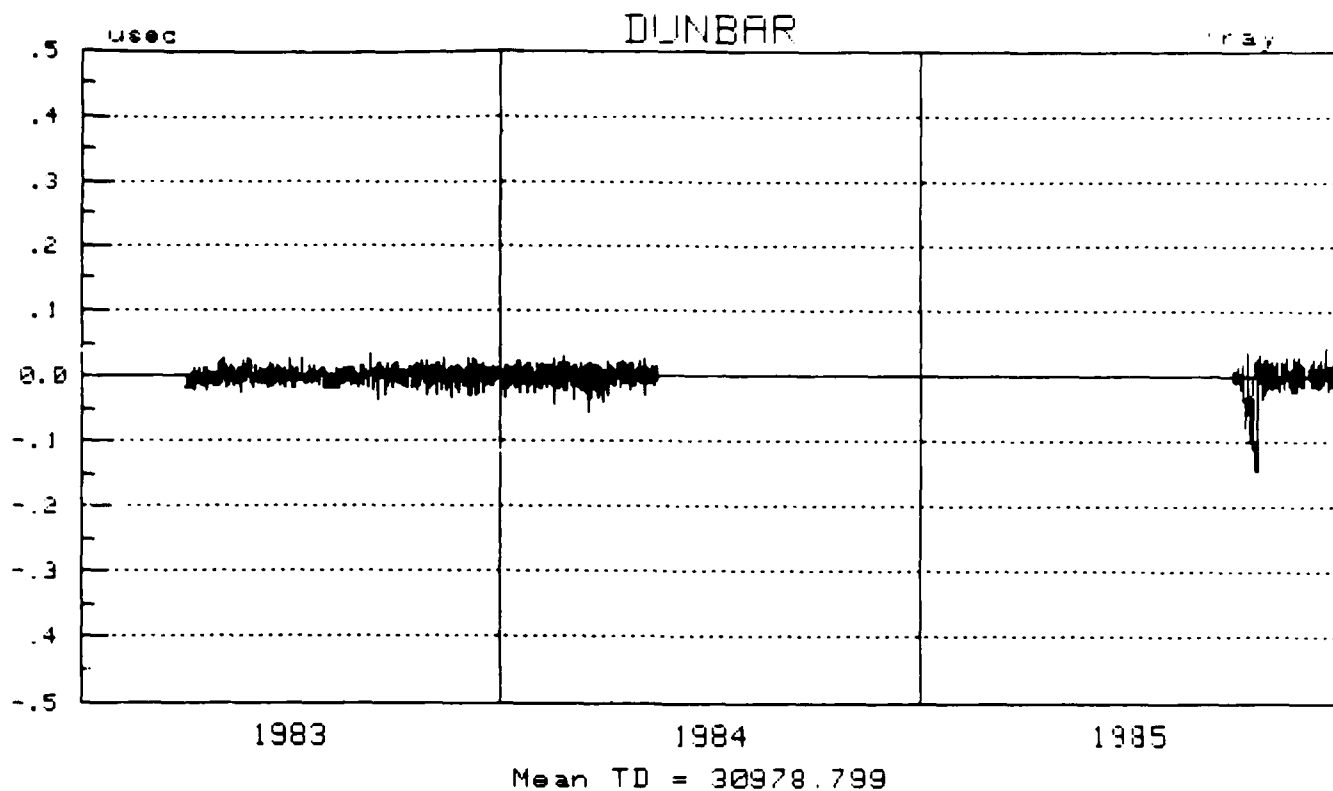
Receiving Antenna Location:

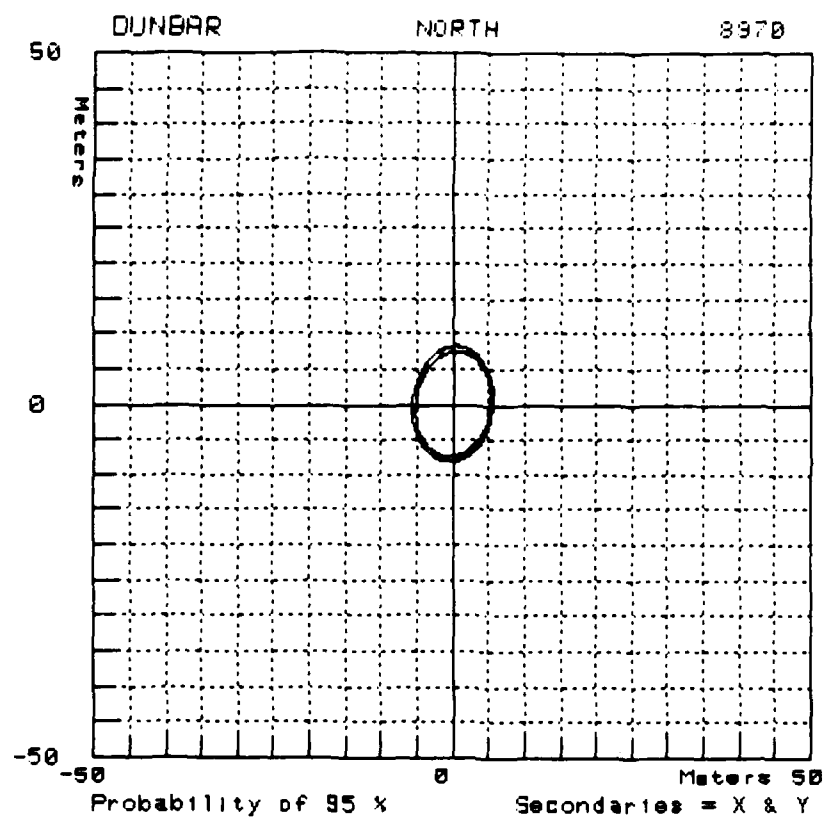
WGS 72
LAT : 46 19 14.37N
LON : 84 13 27.16W

NAD 27
LAT : 46 19 14.43N
LON : 84 13 26.88W

Positioning System
GPS

X-LOP: 161.6 deg Gradients: 767 ft/usec
Y-LOP: 246.6 deg Gradeints: 693 ft/usec





HMS SITE INFORMATION

EAST TAWAS, MICHIGAN

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 01 August 1985 - Present

GRI: 8970 U.S. Great Lakes Chain

TDX: 31057.421
TDY: 49049.594

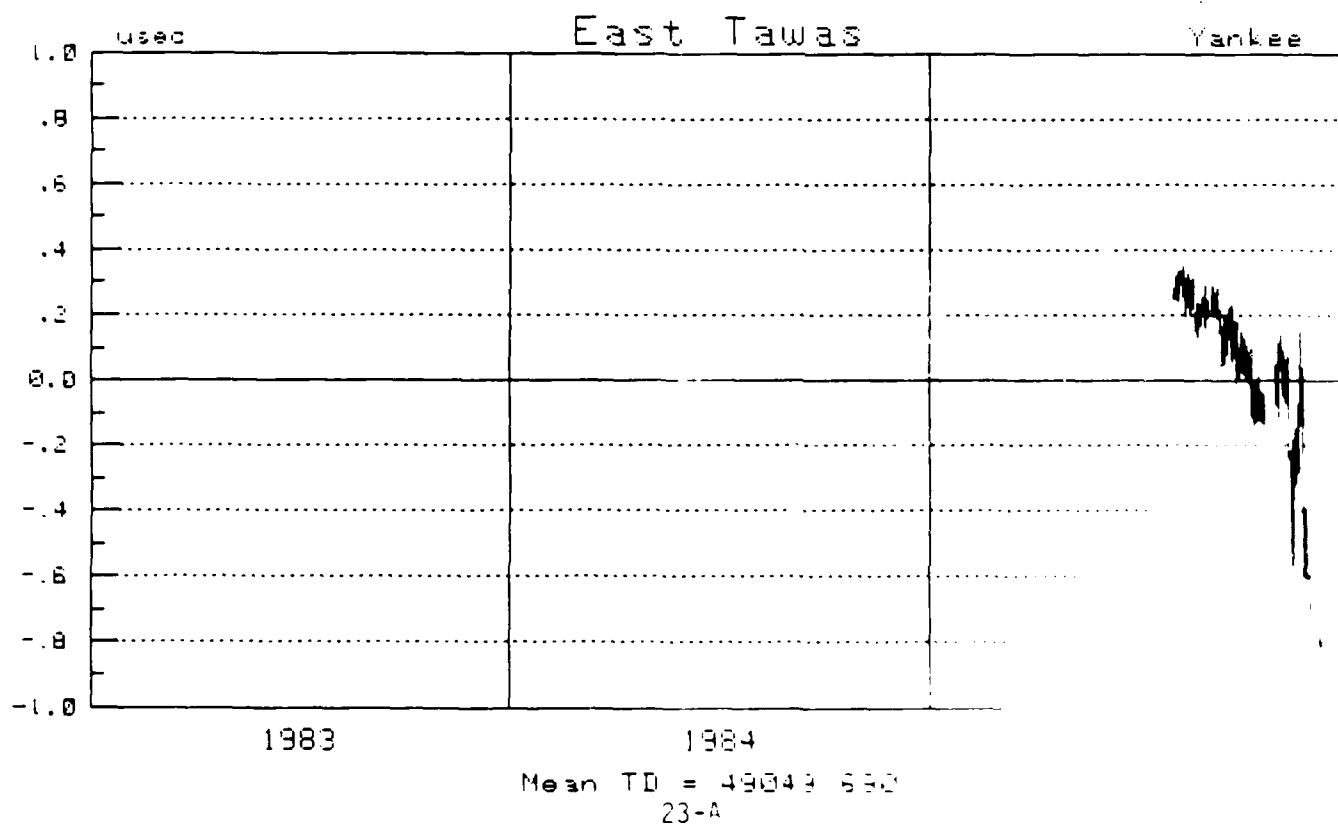
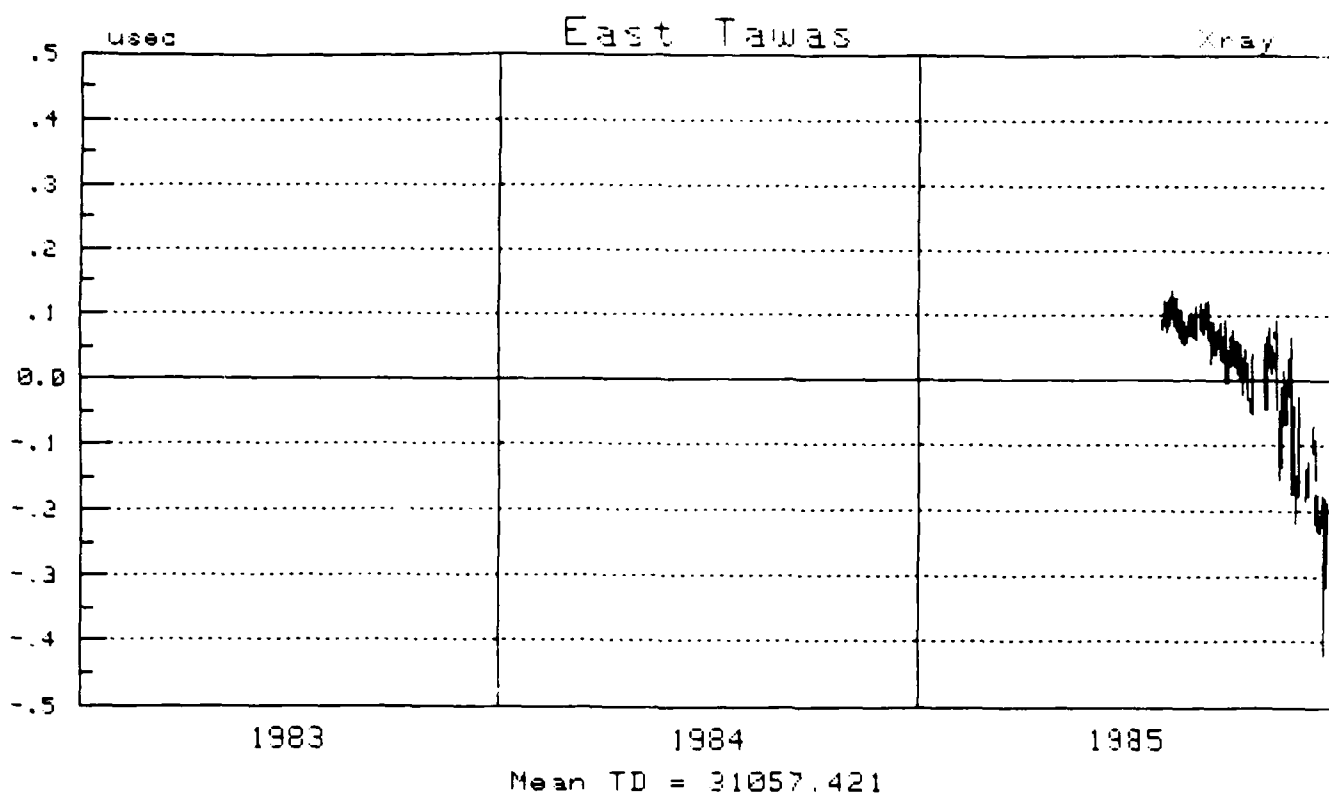
Receiving Antenna Location:

WGS 72
LAT : 44 15 31.93N
LON : 83 26 22.22W

NAD 27
LAT : 44 15 31.97N
LON : 83 26 22.04W

Positioning System
GPS

X-LOP: 160.6 deg Gradients: 599.0 ft/usec
Y-LOP: 259.6 deg Gradients: 709.0 ft/usec



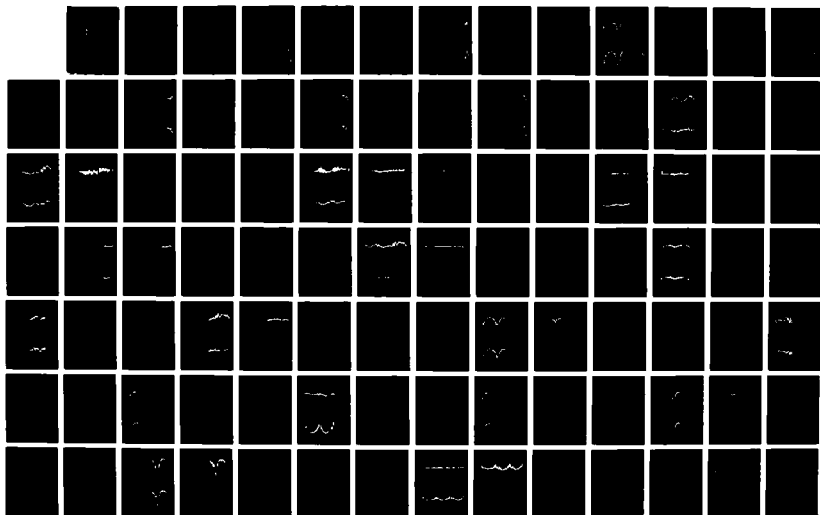
NO-A103 477

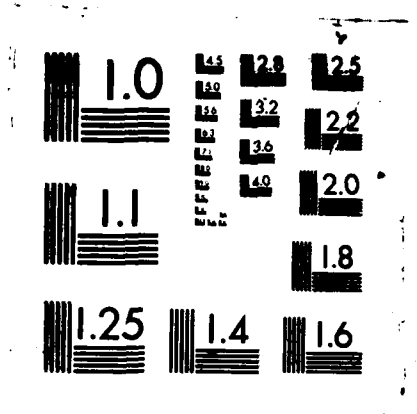
HARBOR MONITOR SYSTEM(U) COAST GUARD RESEARCH AND
DEVELOPMENT CENTER GROTON CT M M BLIZARD ET AL. DEC 86
CGR/DC-03/86 USCG-D-17-87

2/3

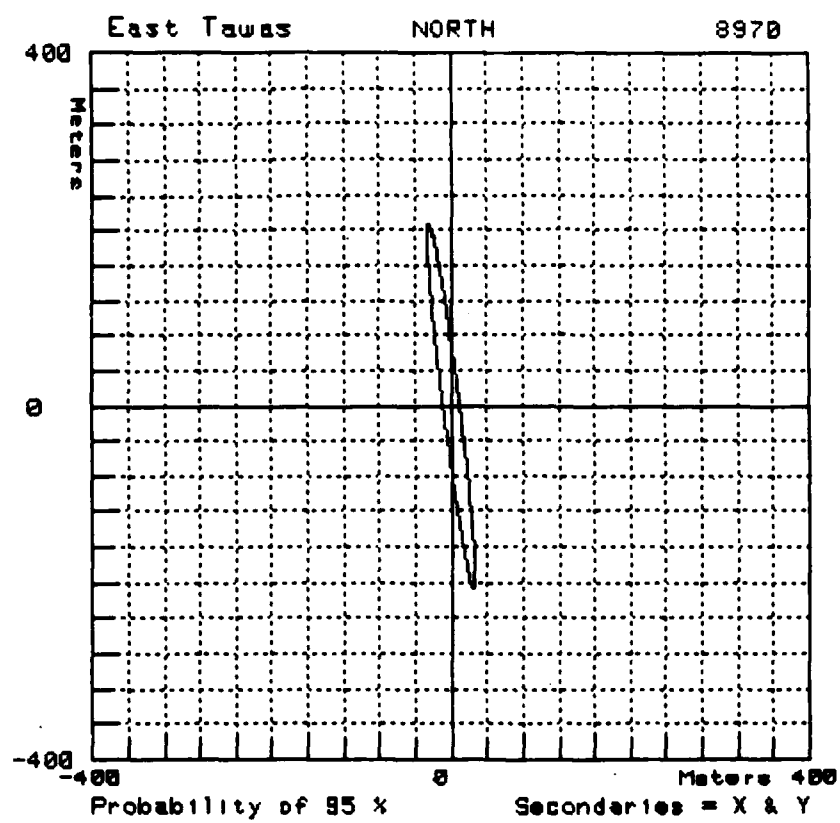
UNCLASSIFIED

F/G 17/7.2 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



HMS SITE INFORMATION

FAIRPORT, OHIO

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: September 1985 - Present

GRI: 8970 Great Lakes Chain

TDX: 30554.829
TDY: 50172.898

Receiving Antenna Location:

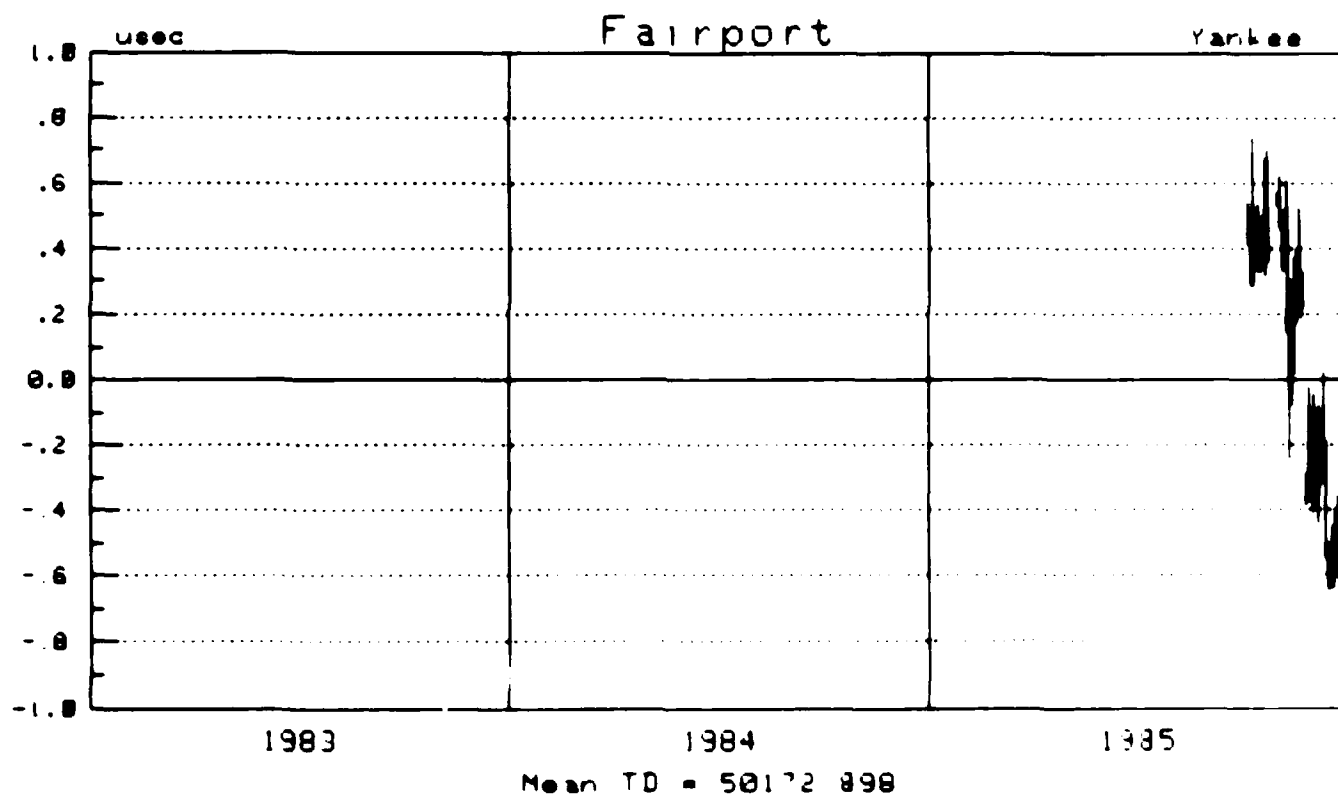
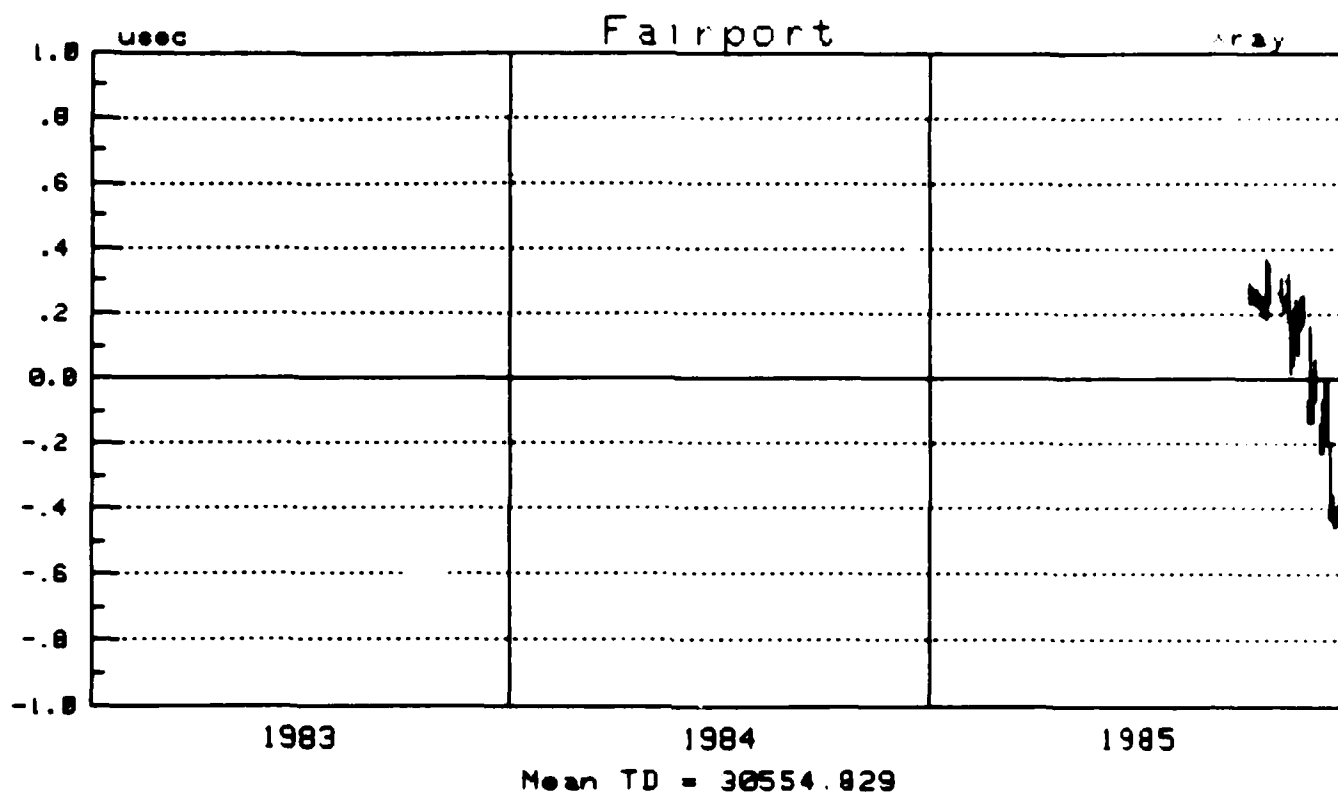
WGS 72
LAT : 41 45 35.88N
LON : 81 16 53.51W

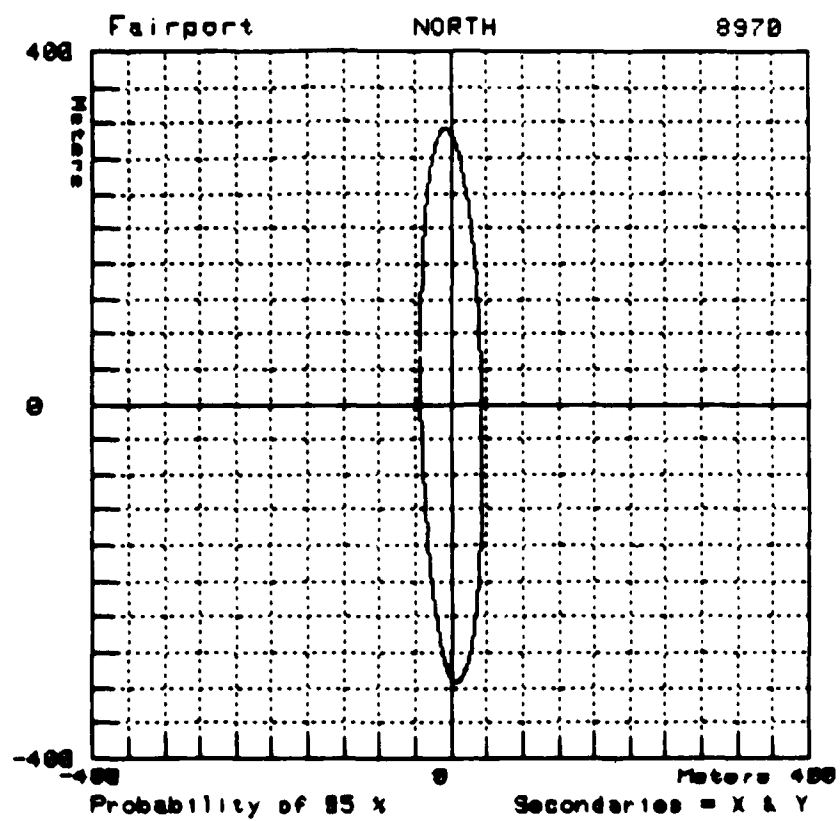
NAD 27
LAT : 41 45 35.87N
LON : 81 16 53.60W

Positioning System
GPS

X-LOP: 72.4 deg
Y-LOP: 310.7 deg

Gradients: 491.7 ft/usec
Gradients: 972.9 ft/usec





HMS SITE INFORMATION

HANCOCK, MICHIGAN

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 01 August 1985 - Present

GRI: 8970 U.S. Great Lakes Chain

TDX: 31934.559
TDY: 46567.314

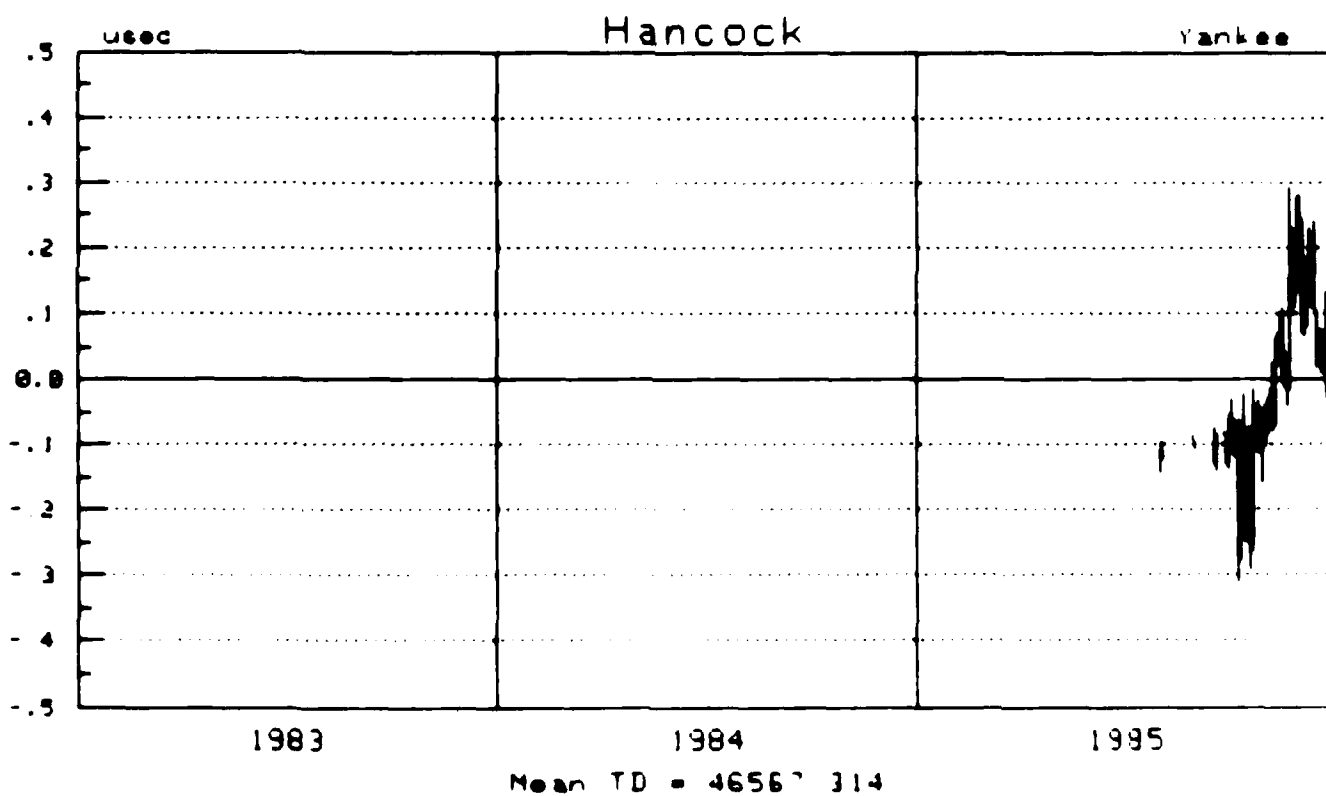
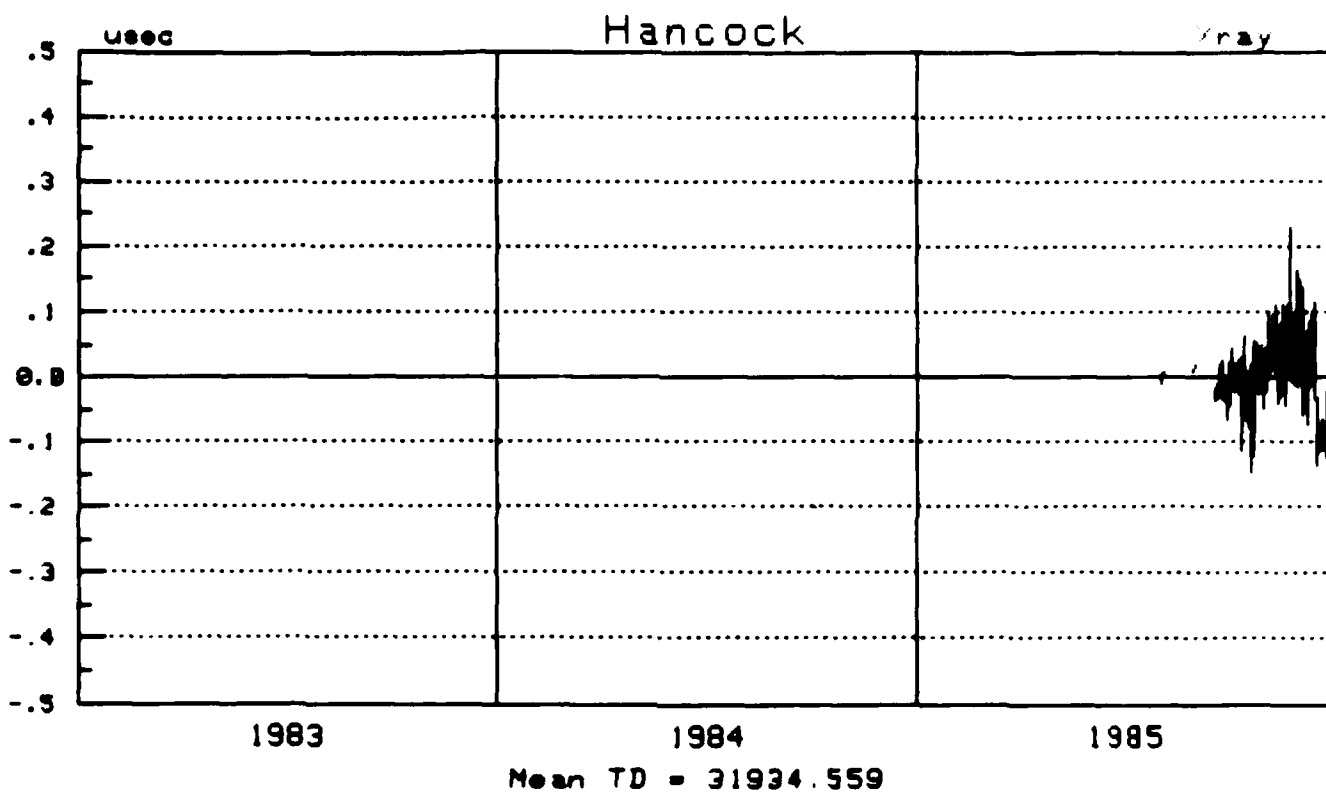
Receiving Antenna Location:

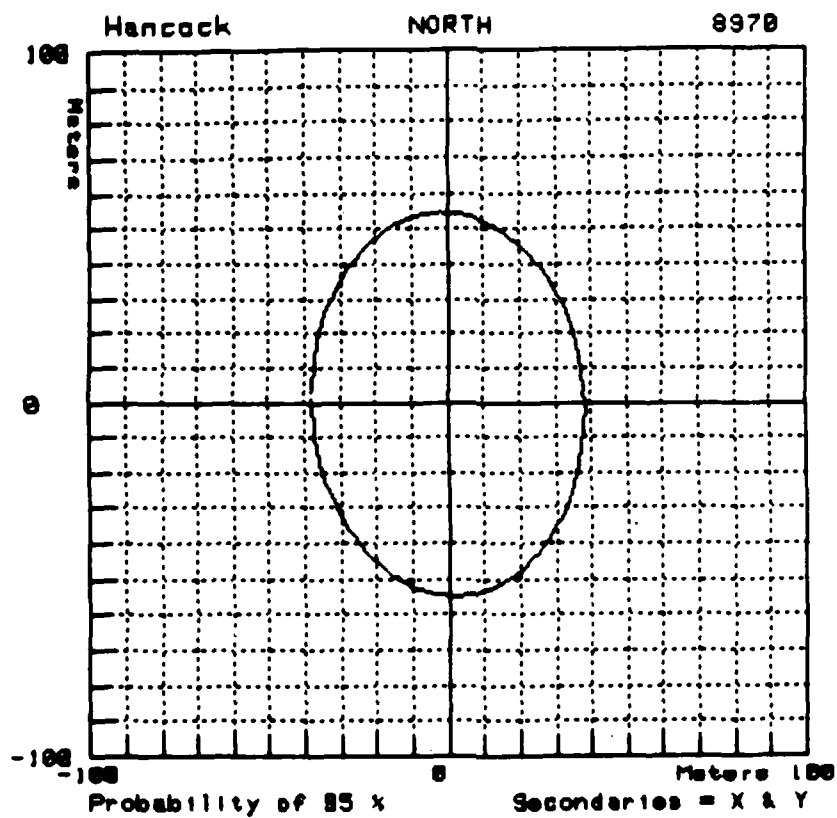
WGS 72
LAT : 47 13 31.13N
LON : 88 37 25.03W

NAD 27
LAT : 47 13 31.21N
LON : 88 37 24.16W

Positioning System
GPS

X-LOP: 143.6 deg Gradients: 995.9 ft/usec
Y-LOP: 232.3 deg Gradients: 573.0 ft/usec





HMS SITE INFORMATION

PLUMBROOK, OHIO

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 14 March 1983 - 24 May 1984
and 25 September 1985 - Present

GRI: 8970 Great Lakes Chain

TDX: 31373.259 A2
TDY: 50395.586 A2

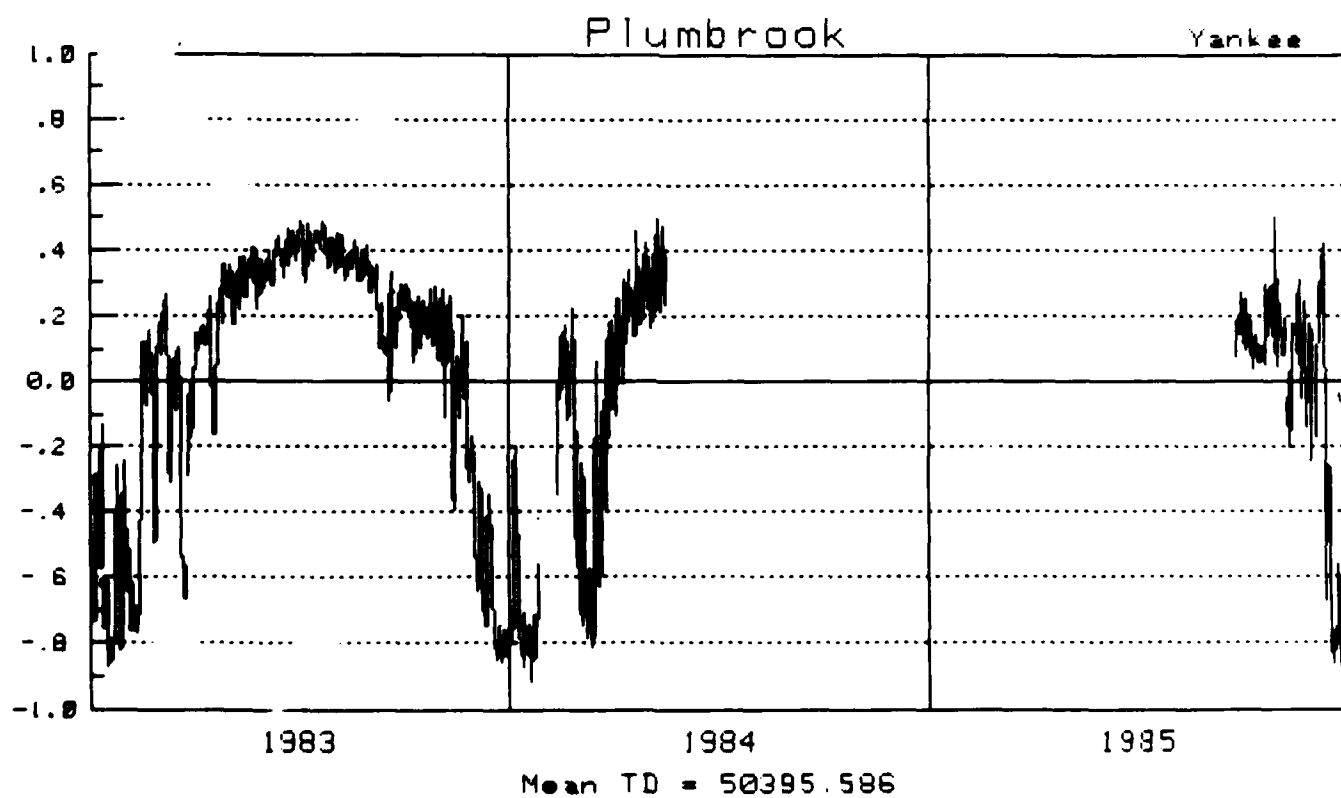
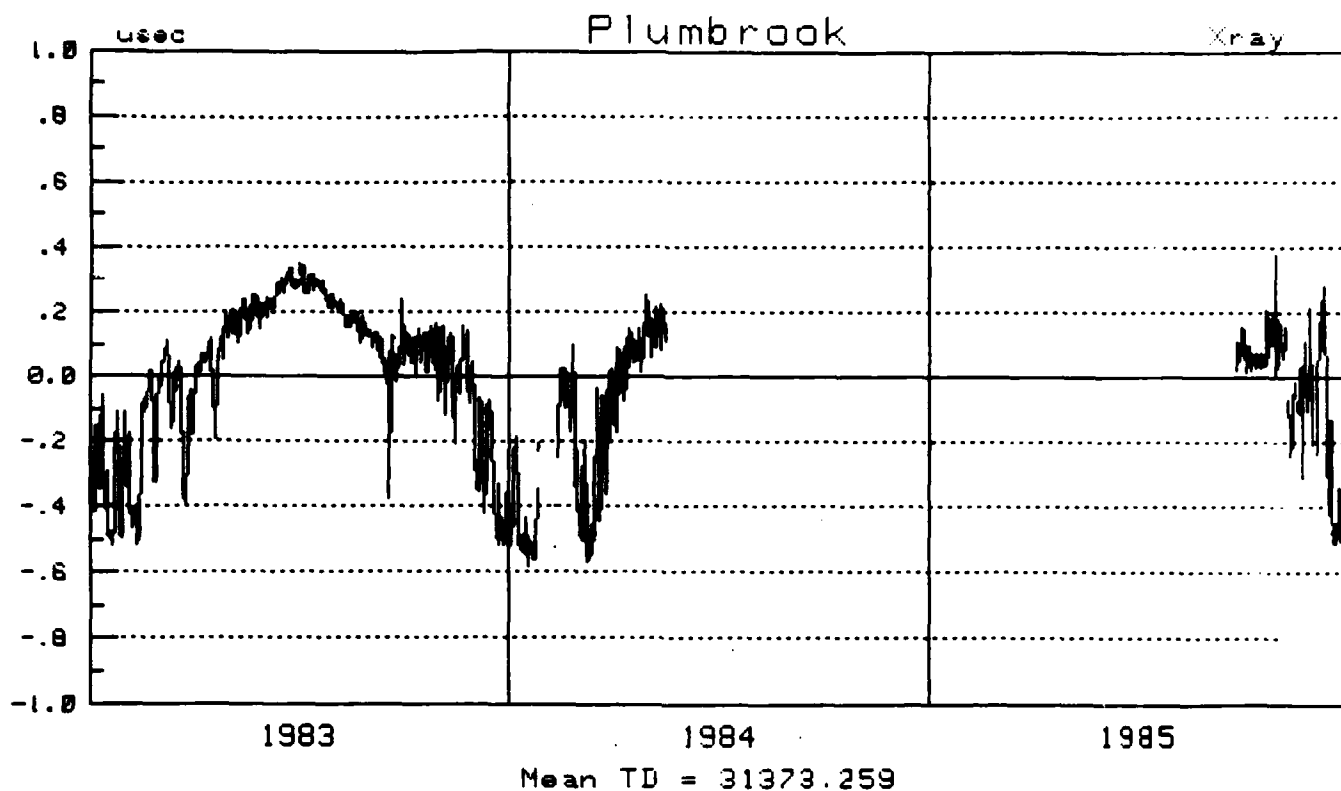
Receiving Antenna Location:

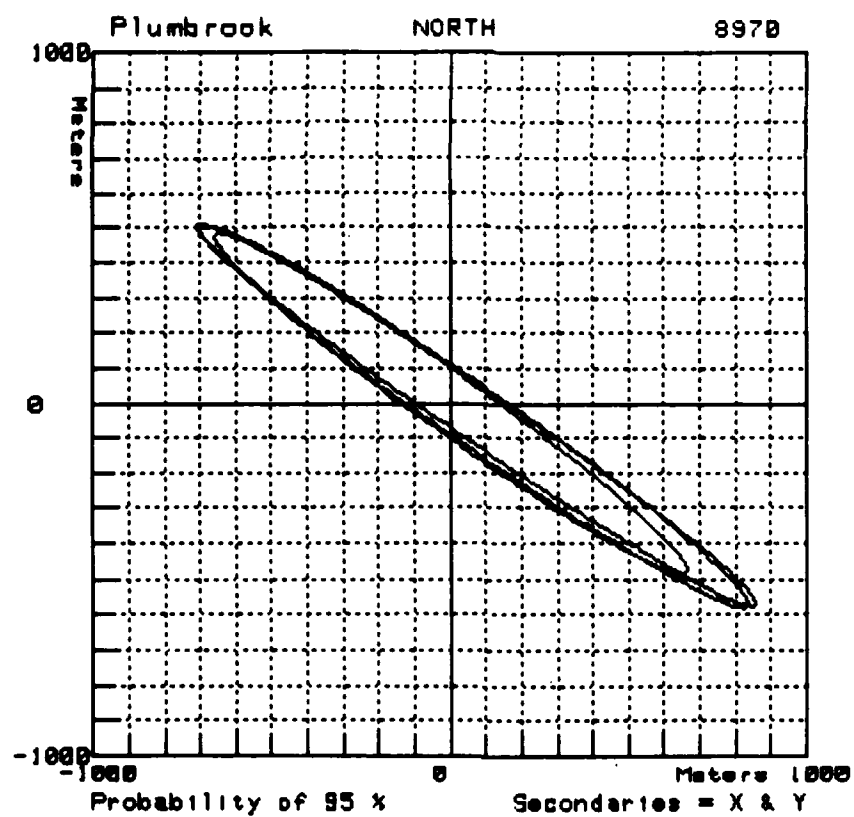
WGS 72
LAT : 41 22 46.96N
LON : 82 39 38.53W

NAD 27
LAT : 41 22 46.94N
LON : 82 39 38.45W

Positioning System
From G-NRN

X-LOP: 160.0 deg Gradients: 492 ft/usec
Y-LOP: 281.9 deg Gradients: 907 ft/usec





HMS SITE INFORMATION

PORT HURON, MICHIGAN

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 16 July 1985 - Present

GRI: 8970 U.S. Great Lakes Chain

TDX: 30859.670
TDY: 49689.225

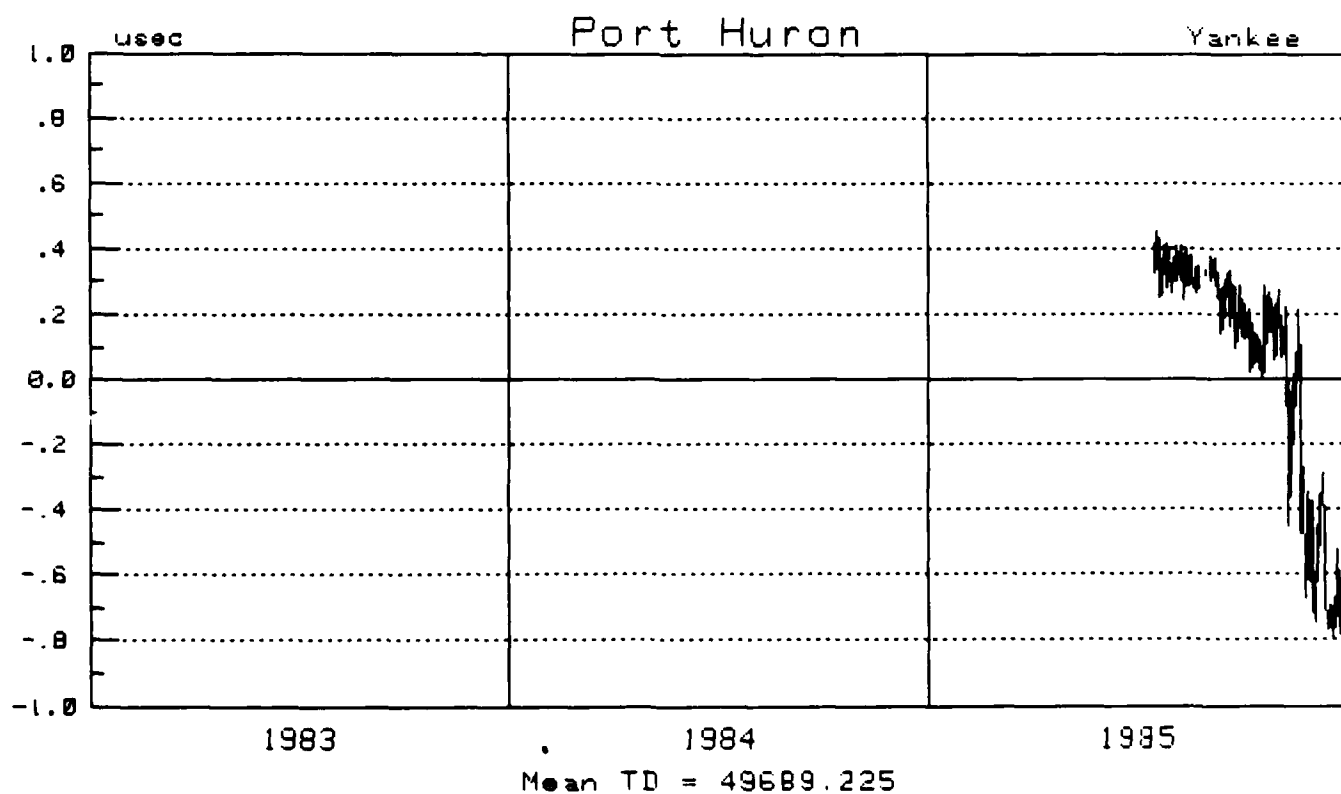
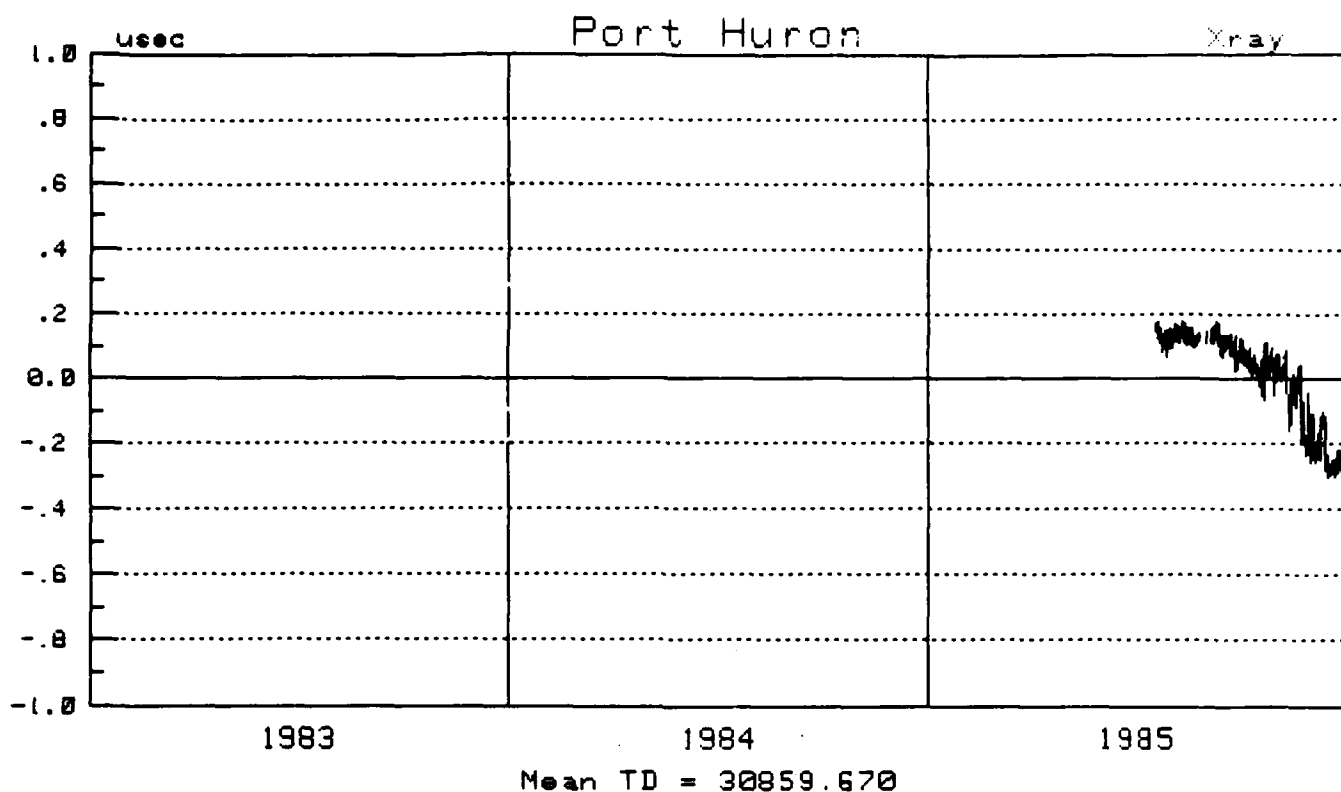
Receiving Antenna Location:

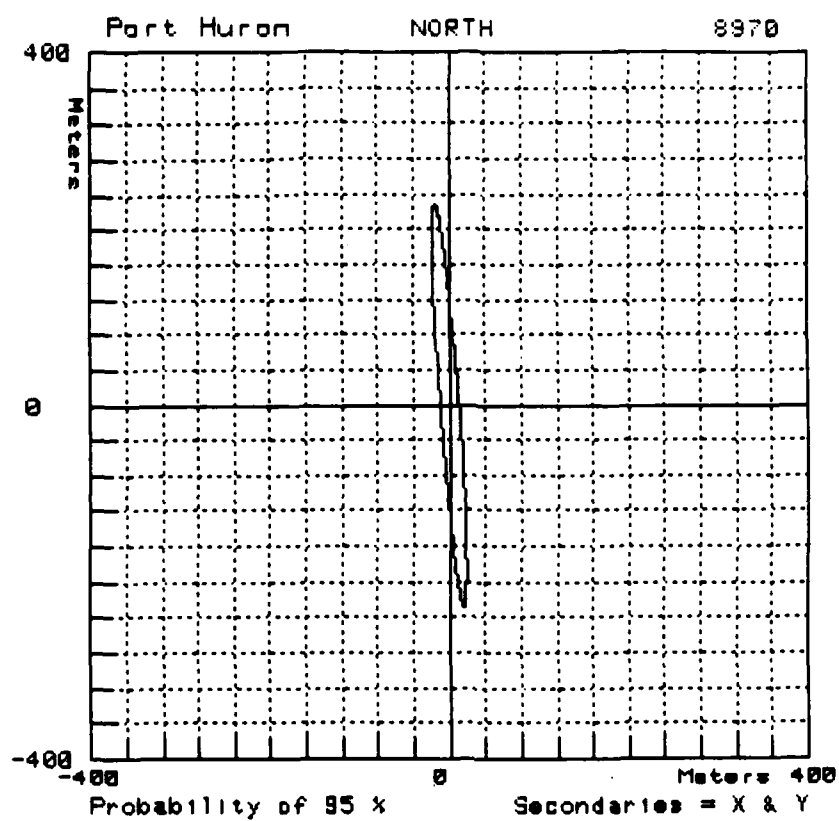
WGS 72
LAT : 43 00 19.70N
LON : 82 25 26.02W

NAD 27
LAT : 43 00 19.72N
LON : 82 25 25.97W

Positioning System
GPS

X-LOP: 162.1 deg Gradients: 523 ft/usec
Y-LOP: 269.9 deg Gradients: 801 ft/usec





HMS SITE INFORMATION

ST. IGNACE, MICHIGAN

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 16 July 1985 - Present

GRI: 8970 U.S. Great Lakes Chain

TDX: 31208.795

TDY: 48092.070

Receiving Antenna Location:

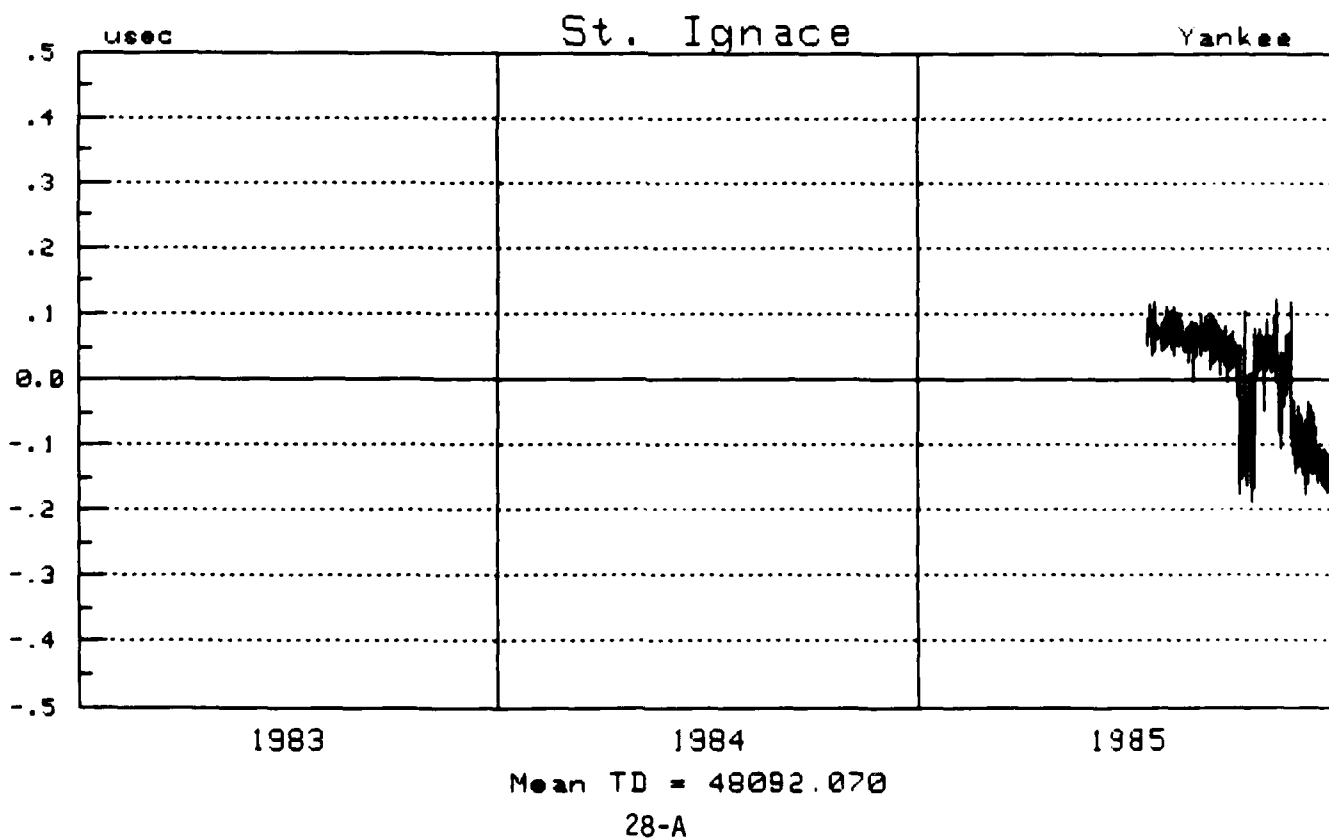
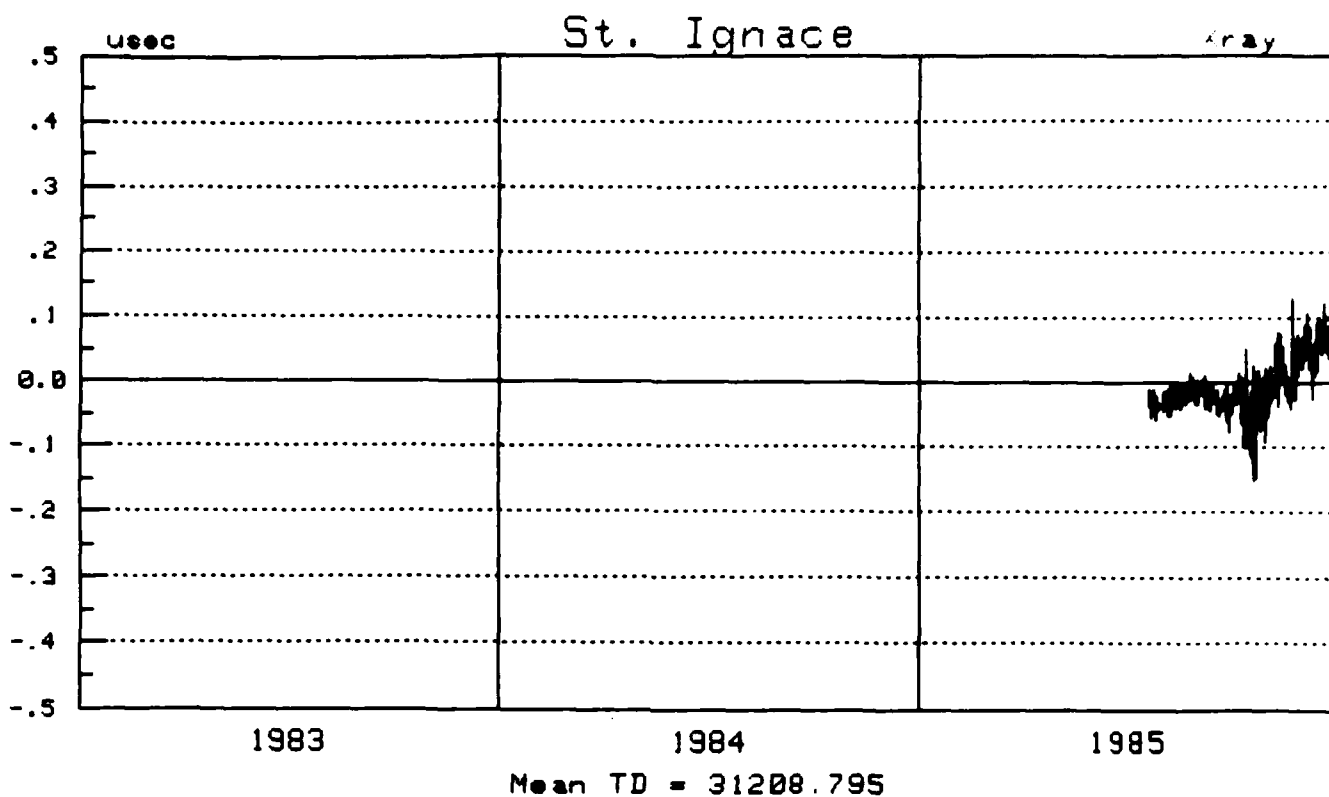
WGS 72
LAT : 45 51 16.87N
LON : 84 42 13.73W

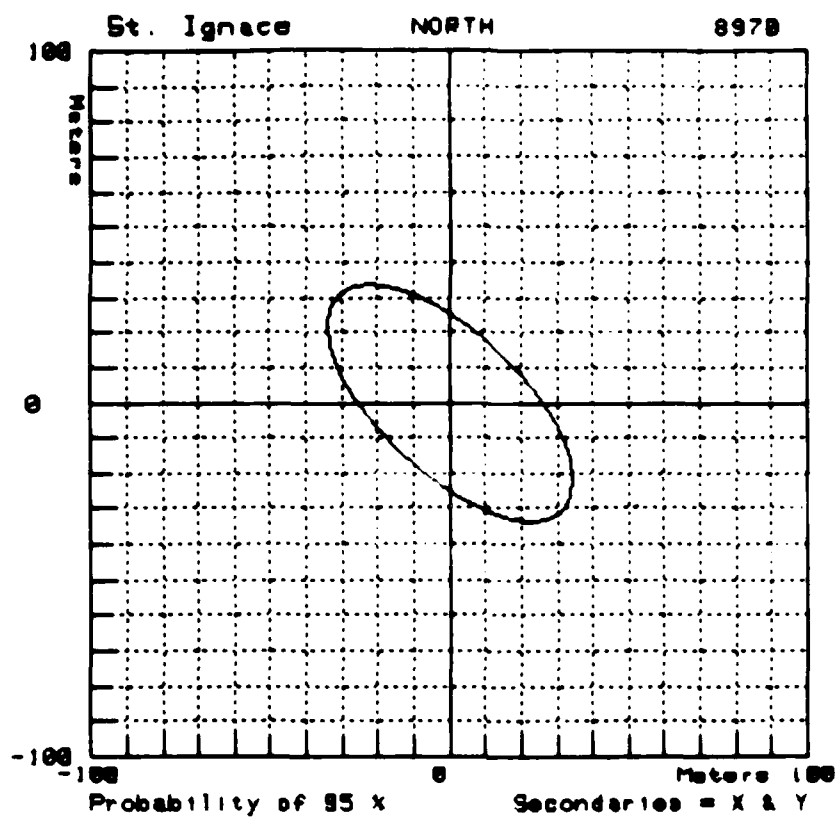
NAD 27
LAT : 45 51 16.93N
LON : 84 42 13.39W

Positioning System
GPS

X-LOP: 157.8 deg
Y-LOP: 247.6 deg

Gradients: 741 ft/usec
Gradients: 659 ft/usec





WMS SITE INFORMATION

ST. JOSEPH, MICHIGAN

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 20 June 1985 - Present

GRI: 8970 U.S. Great Lakes Chain

TDX: 32941.283

TDY: 50072.192

Receiving Antenna Location:

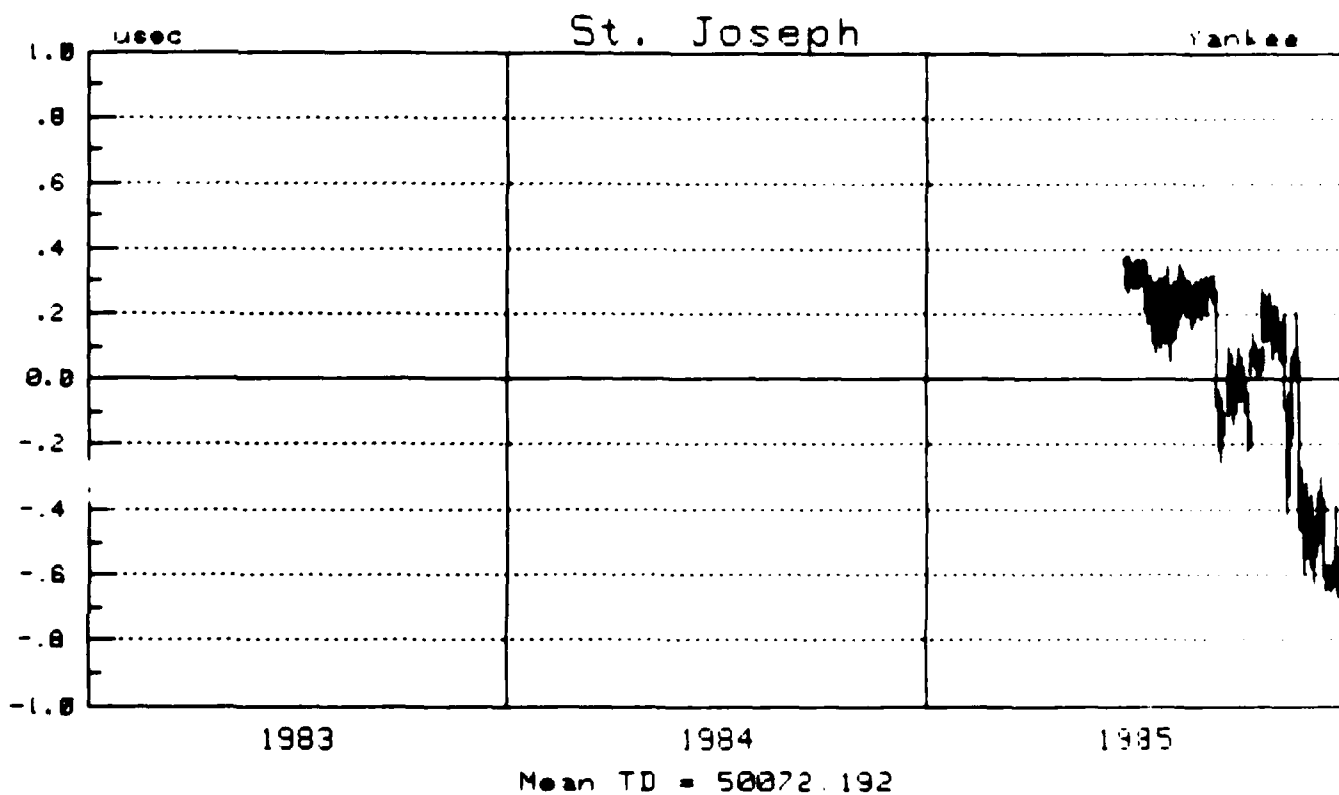
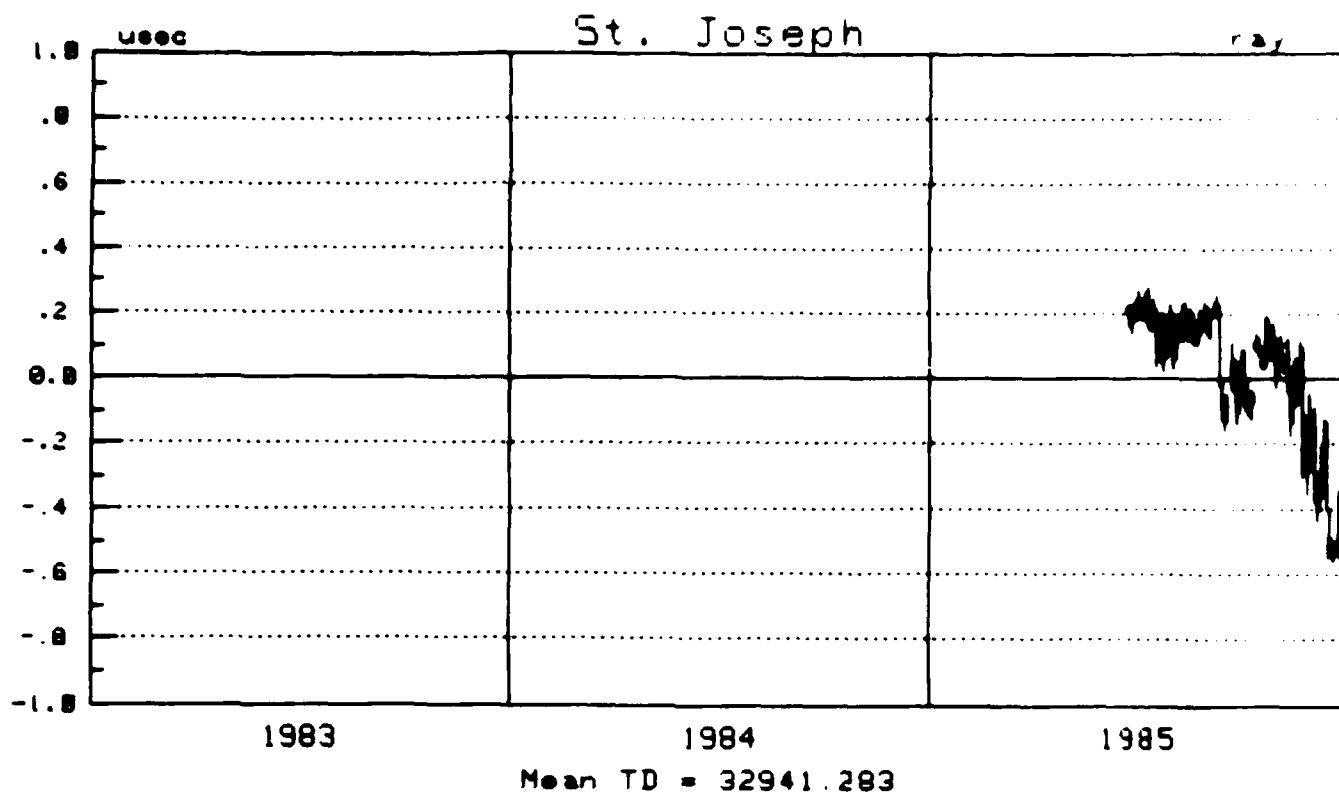
WGS 72
LAT : 42 06 49.05N
LON : 86 29 07.5 W

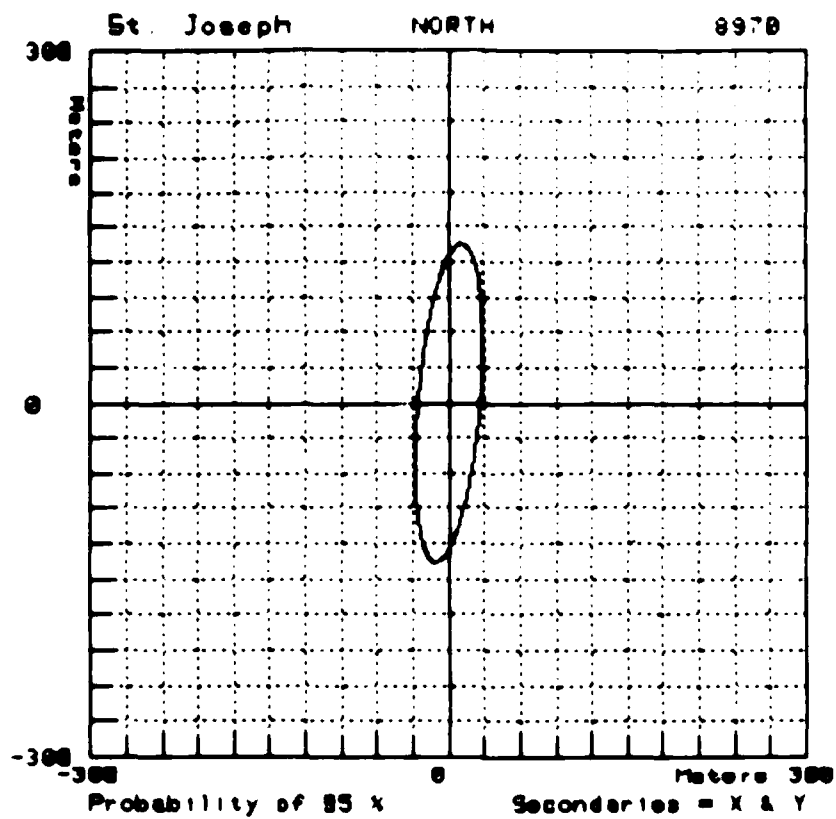
NAD 27
LAT : 42 06 49.06N
LON : 80 29 06.96W

Positioning System
GPS

X-LOP: 140.6 deg
Y-LOP: 260.5 deg

Gradients: 575 ft/usec
Gradients: 561 ft/usec





WMS SITE INFORMATION

STURGEON BAY, WISCONSIN

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 12 August 1985 - Present

GRI: 8970 U.S. Great Lakes Chain

TDX: 32250.948

TDY: 48249.595

Receiving Antenna Location:

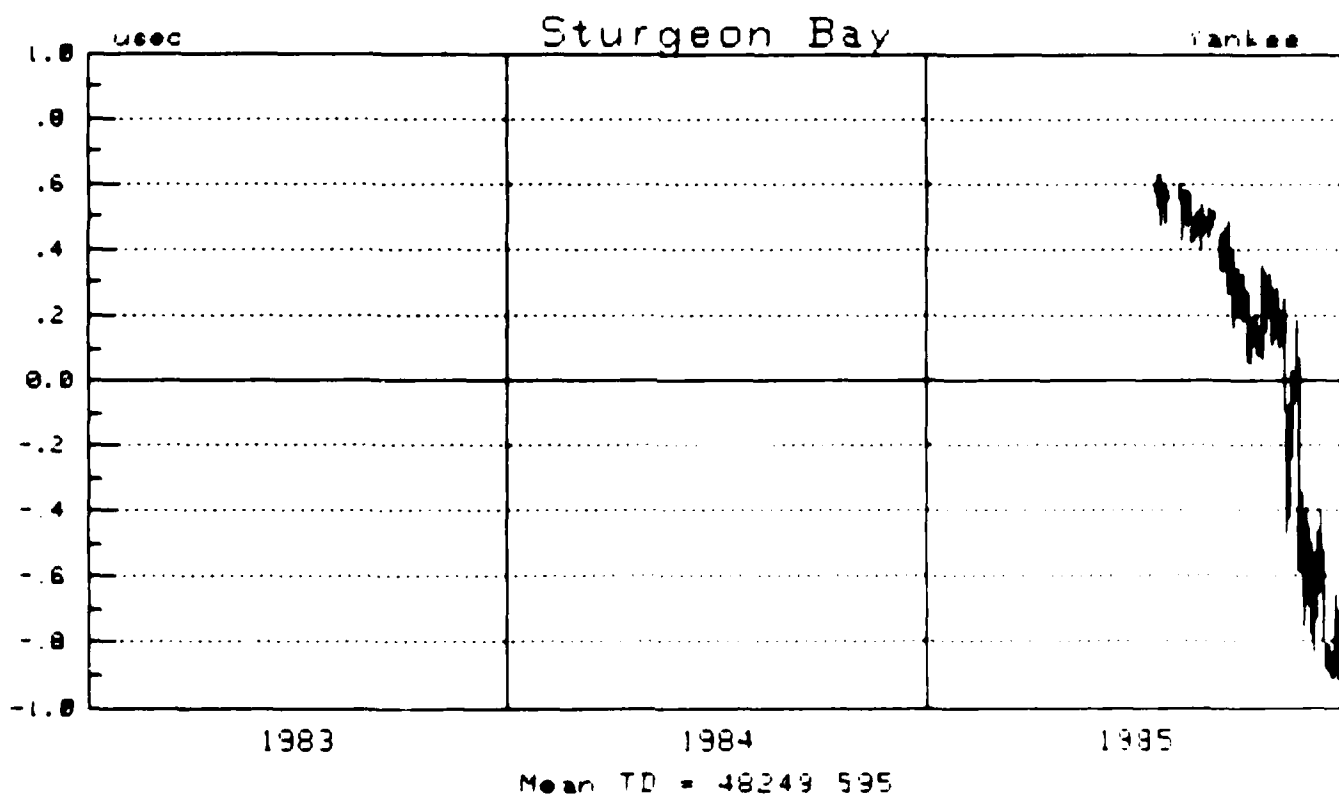
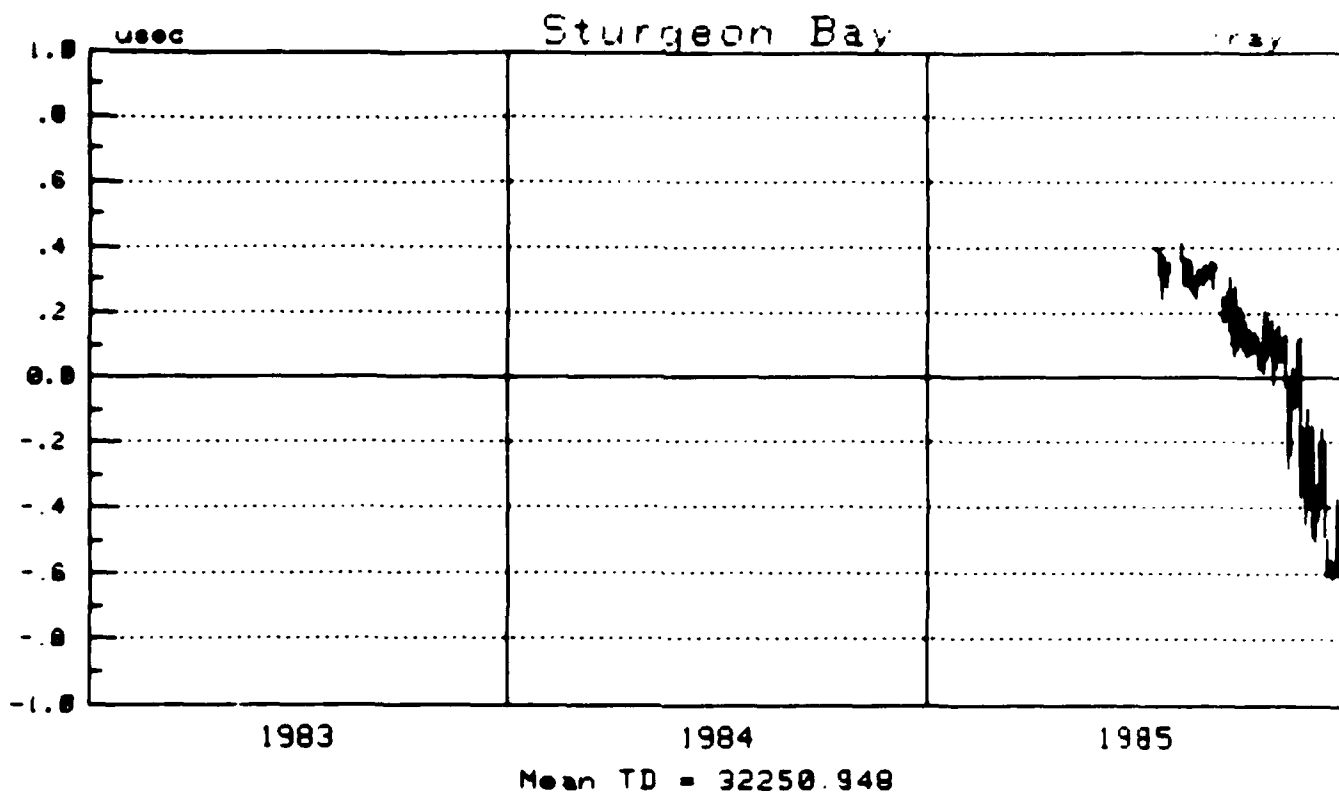
WGS 72
LAT : 44 47 40.51N
LON : 87 18 48.75W

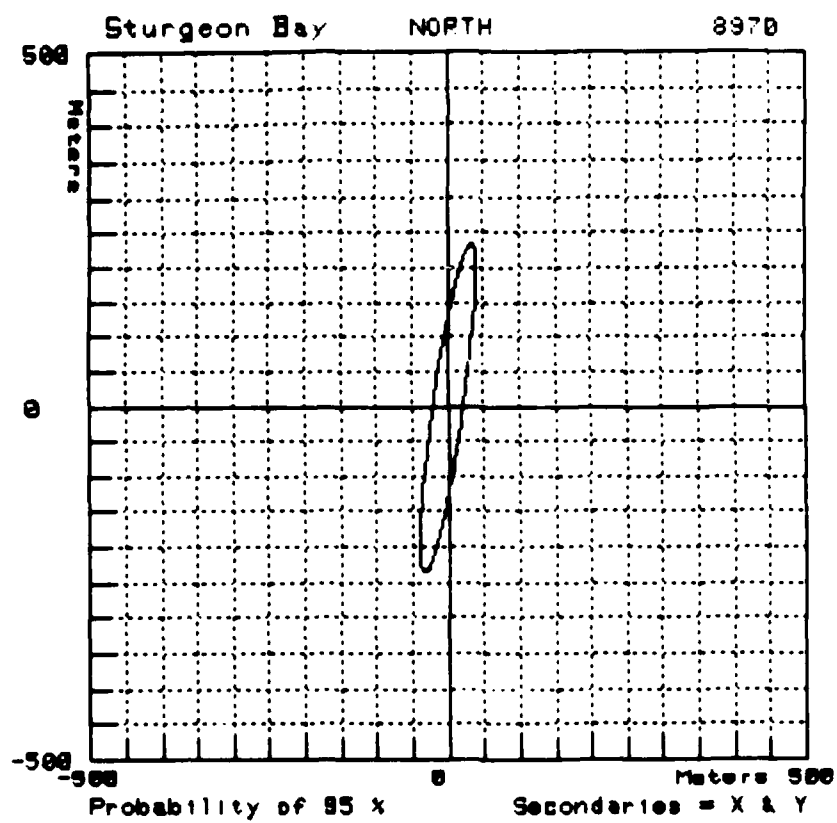
NAD 27
LAT : 44 47 40.57N
LON : 87 18 45.09W

Positioning System
GPS

X-LOP: 141.6 deg
Y-LOP: 245.8 deg

Gradients: 765.5 ft/usec
Gradients: 545.8 ft/usec





HMS SITE INFORMATION

ASTORIA, OREGON

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 06 August 1982 - May 1985

GRI: 9940 U.S. West Coast Chain

TDW: 12060.676
TDX: 28061.199

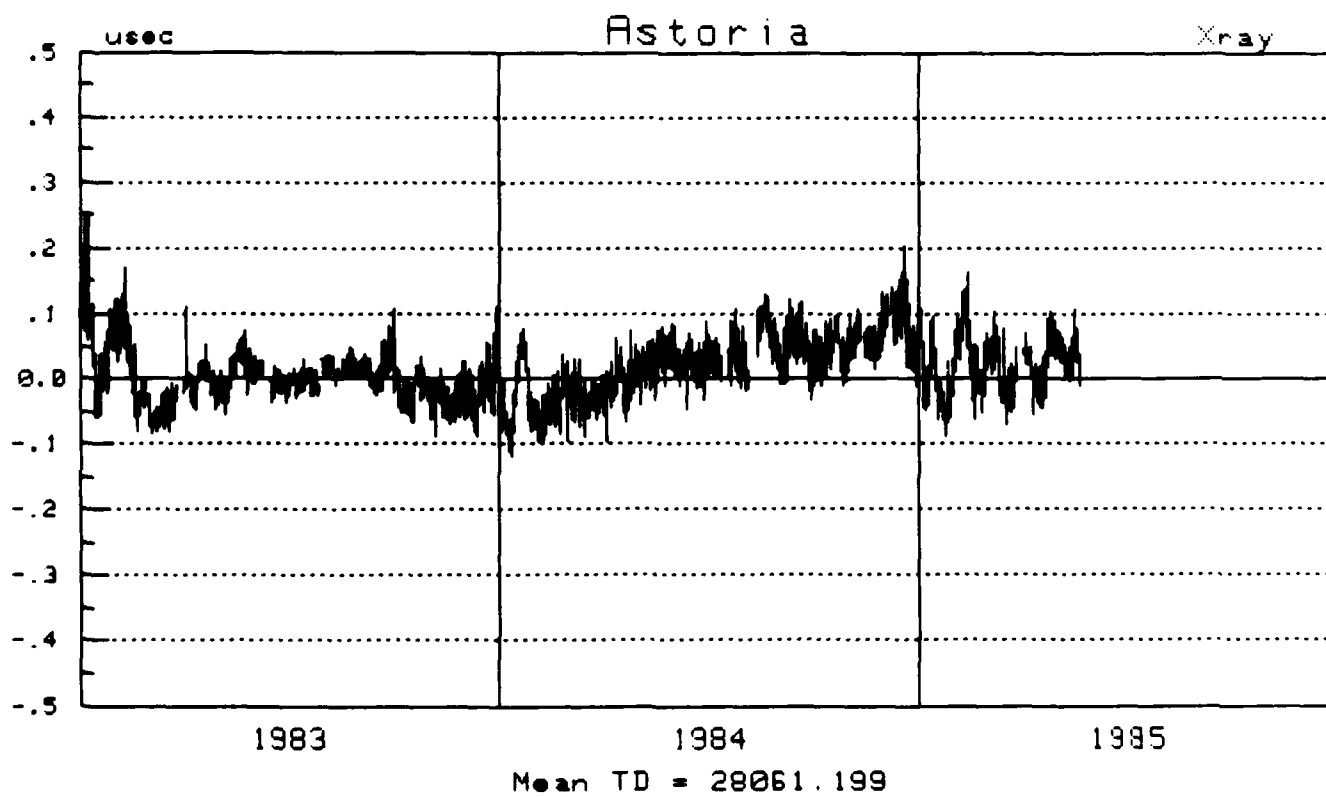
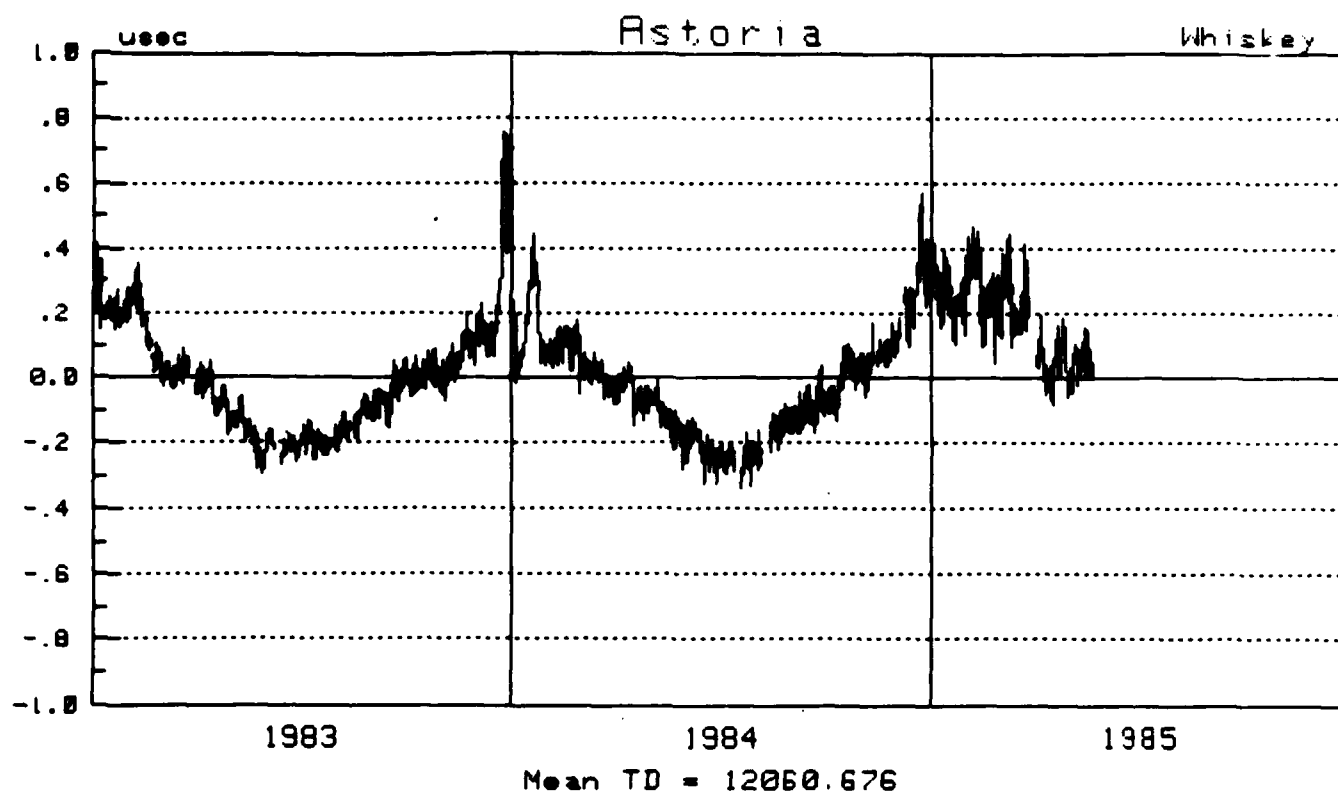
Receiving Antenna Location:

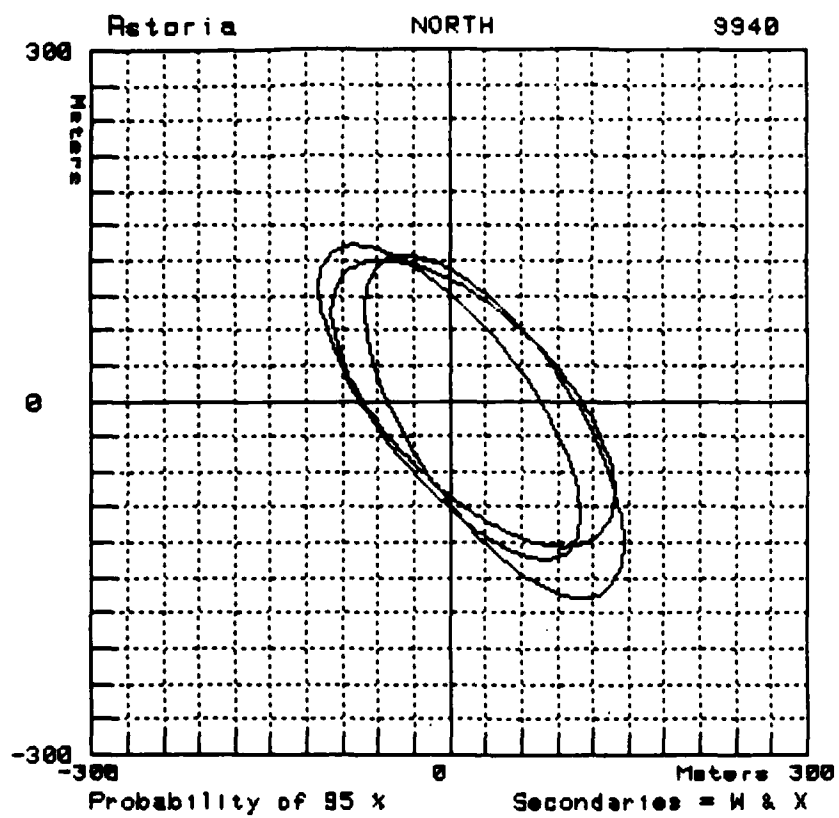
WGS 72
LAT : 46 12 28.72N
LON : 123 46 4.65W

NAD 27
LAT : 46 12 29.72N
LON : 123 45 59.73W

Positioning System
GPS

W-LOP: 110.6 deg Gradients: 779 ft/usec
X-LOP: 161.1 deg Gradients: 2503 ft/usec





HMS SITE INFORMATION

BROOKINGS, OREGON

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 08 June 1983 - 3 February 1986

GRI: 9940 West Coast Chain

TDW: 14221.887
TDX: 27615.629
TDY: 43887.041

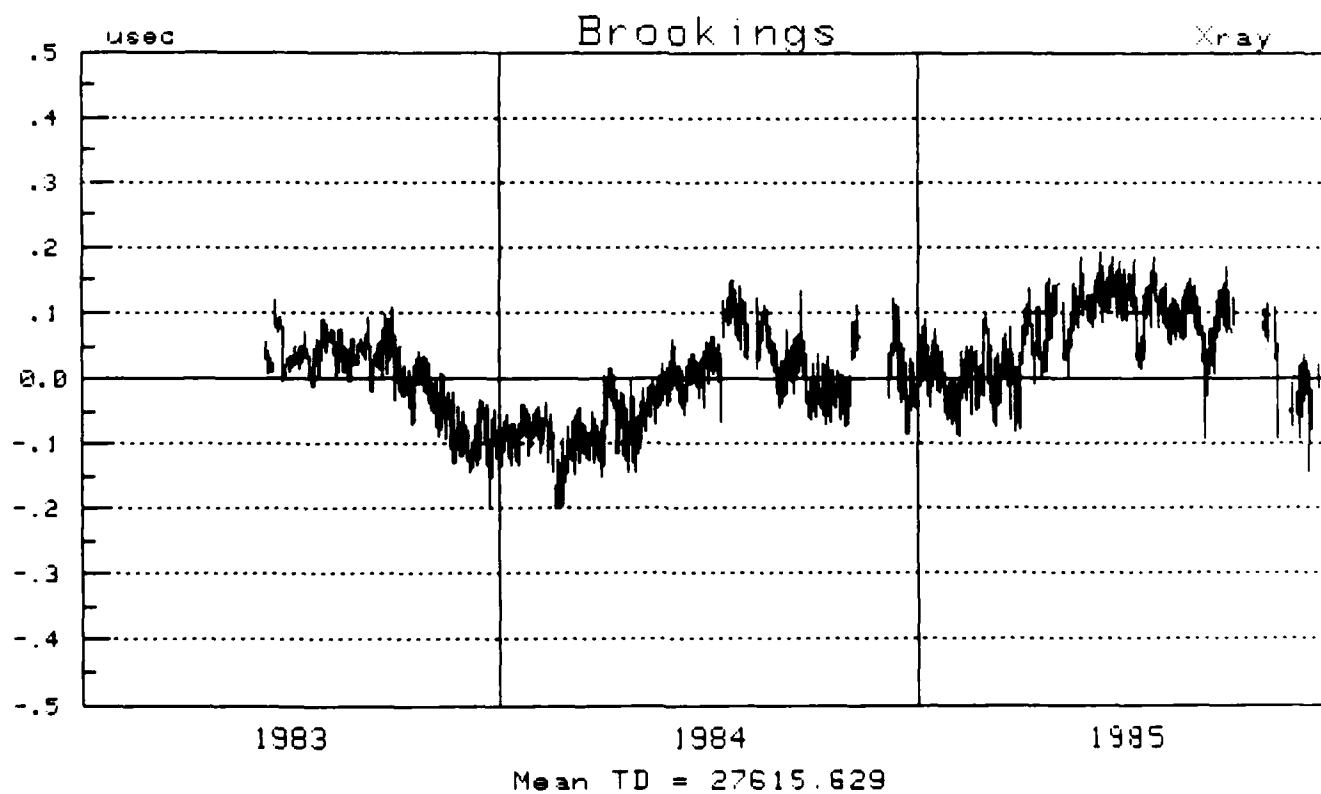
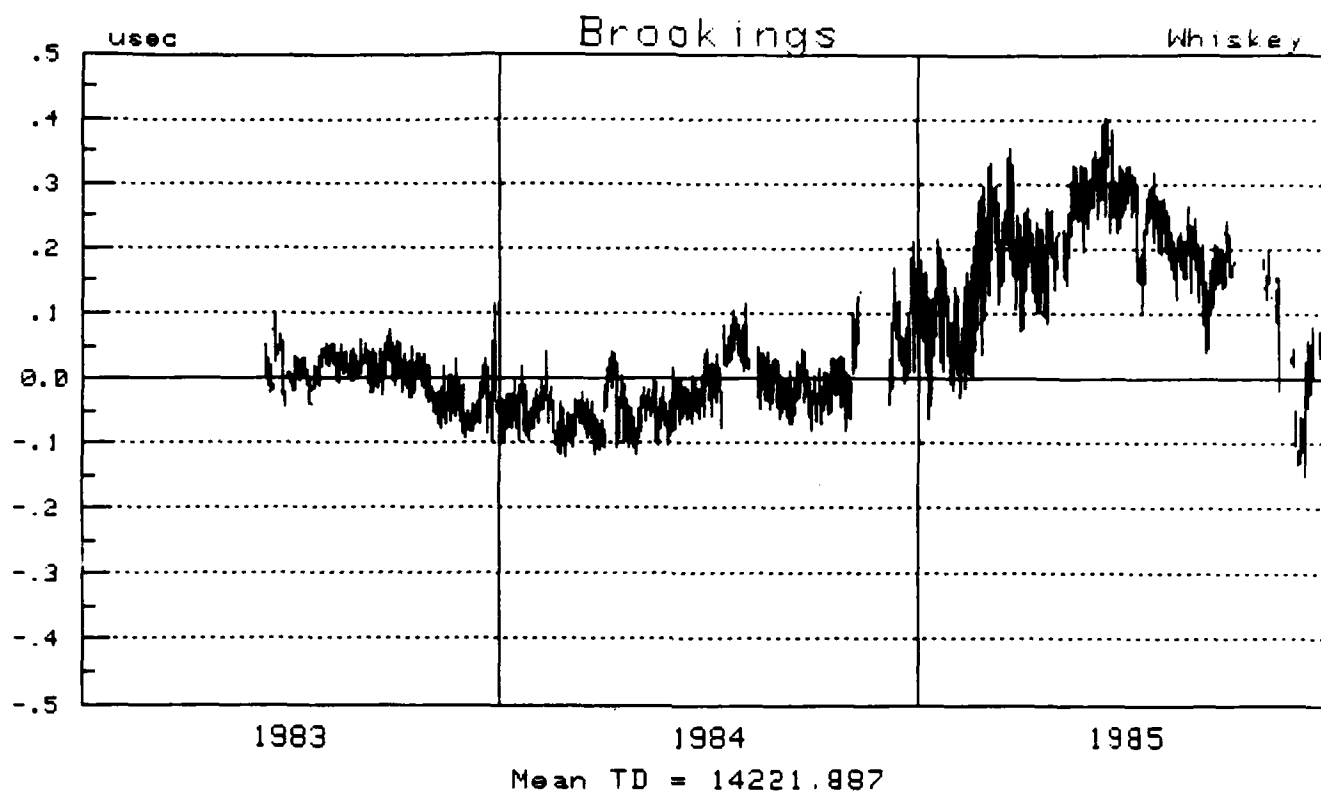
Receiving Antenna Location:

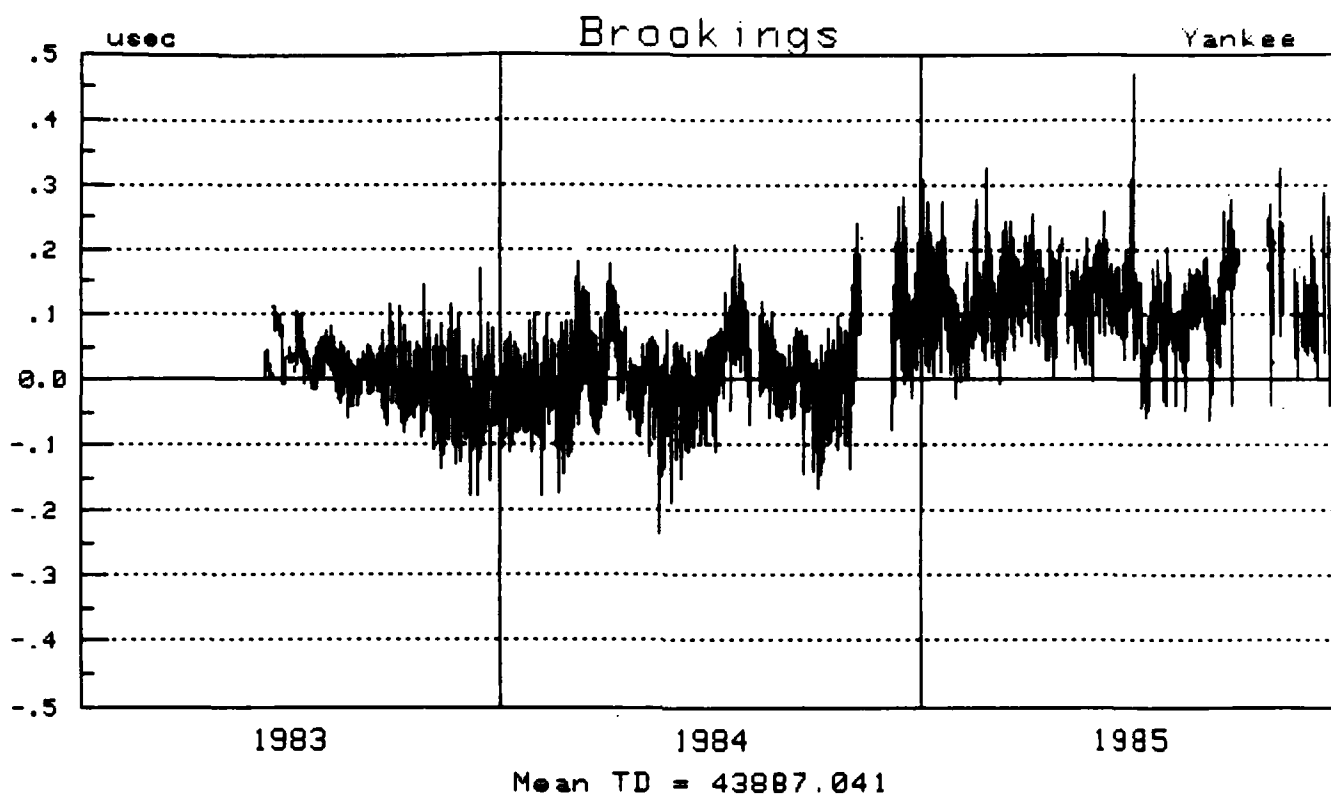
WGS 72
LAT : 42 02 47.8 N
LON : 124 16 07.46W

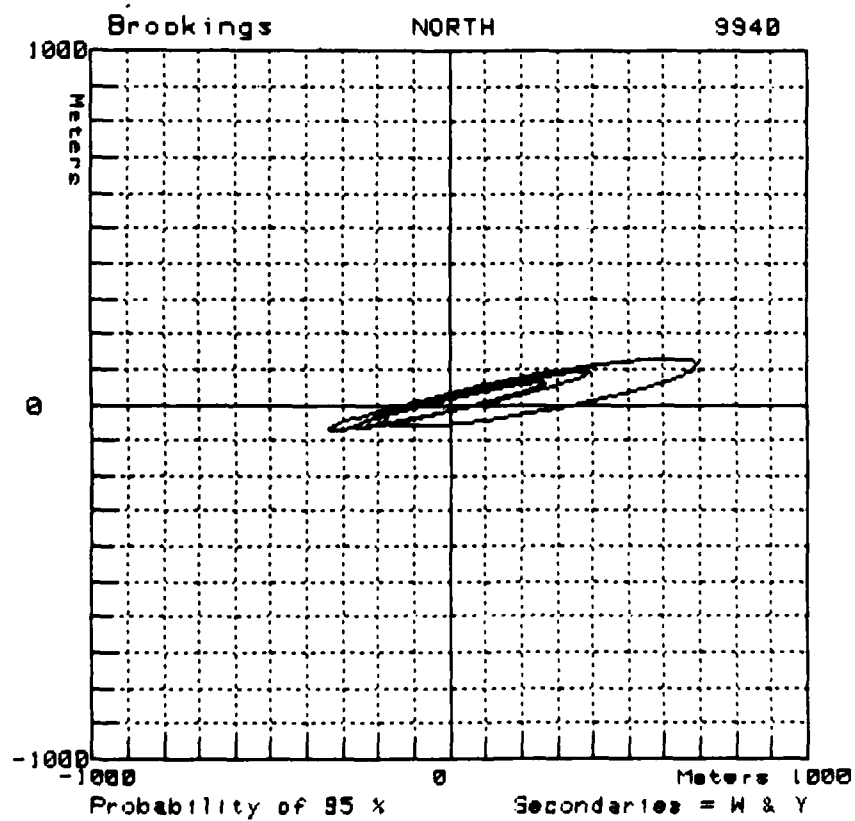
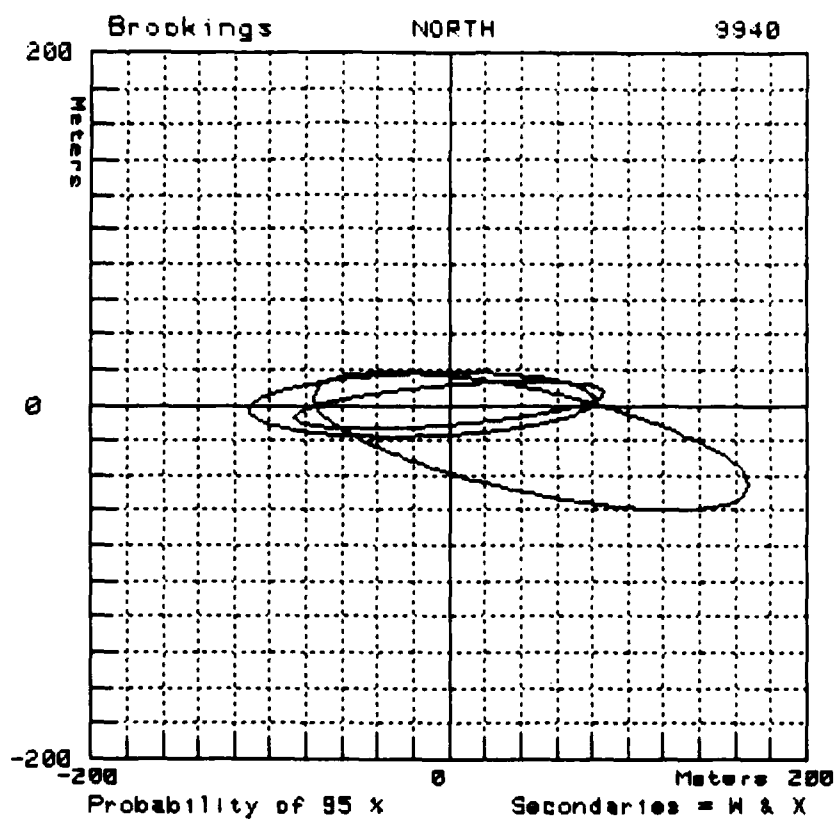
NAD 27
LAT : 42 02 48.69N
LON : 124 16 2.83W

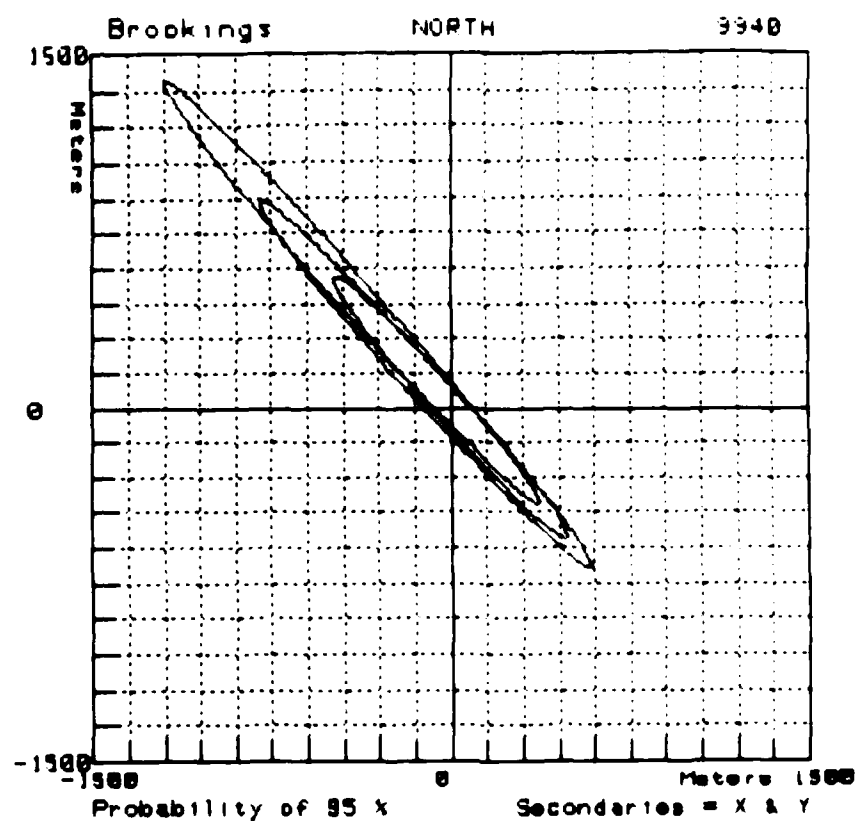
Positioning System
GPS

W-LOP: 75.3 deg	Gradients: 707 ft/usec
X-LOP: 138.2 deg	Gradients: 1527 ft/usec
Y-LOP: 124.4 deg	Gradients: 5747 ft/usec









HMS SITE INFORMATION

CAMBRIA, CALIFORNIA

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 24 May 1983 - 20 March 1986

GRI: 9940 U.S. West Coast Chain

TDW: 16462.303
TDX: 27743.229
TDY: 42231.747

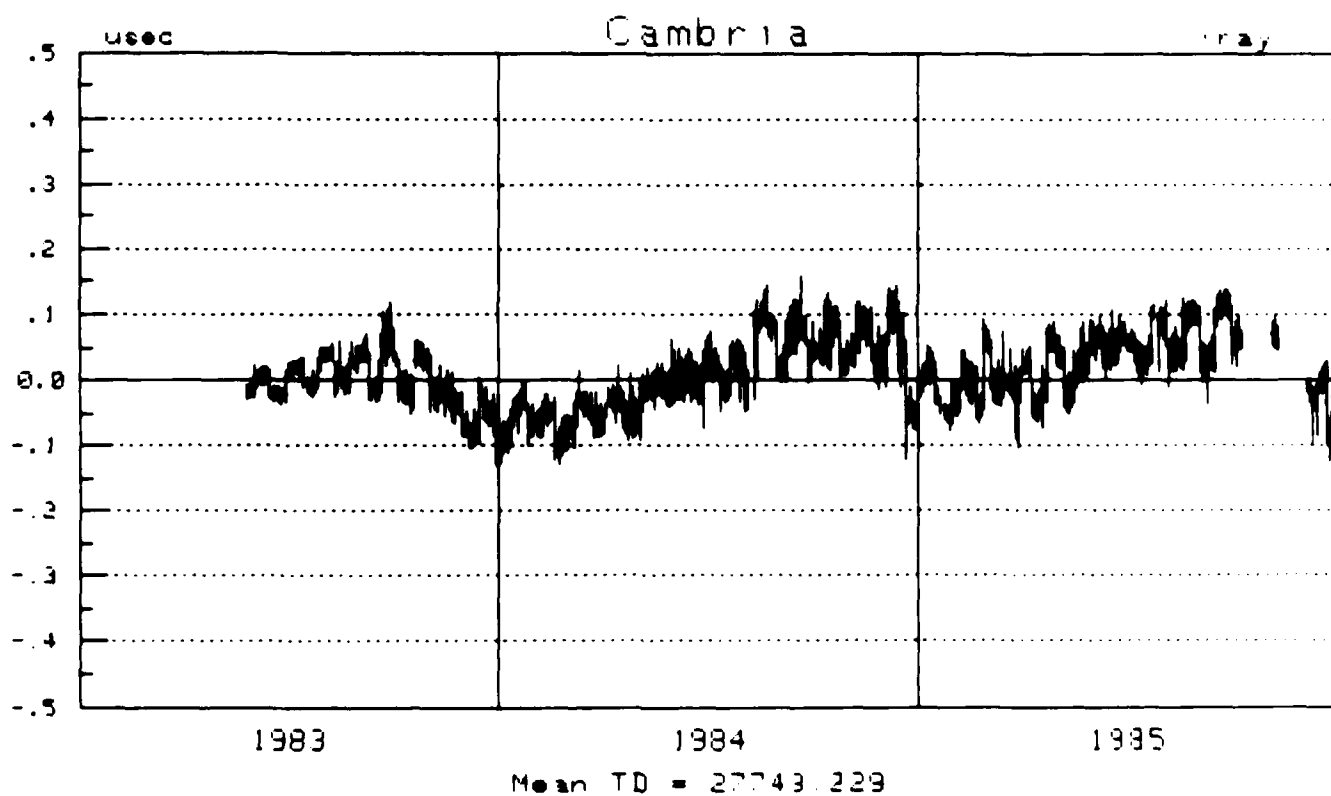
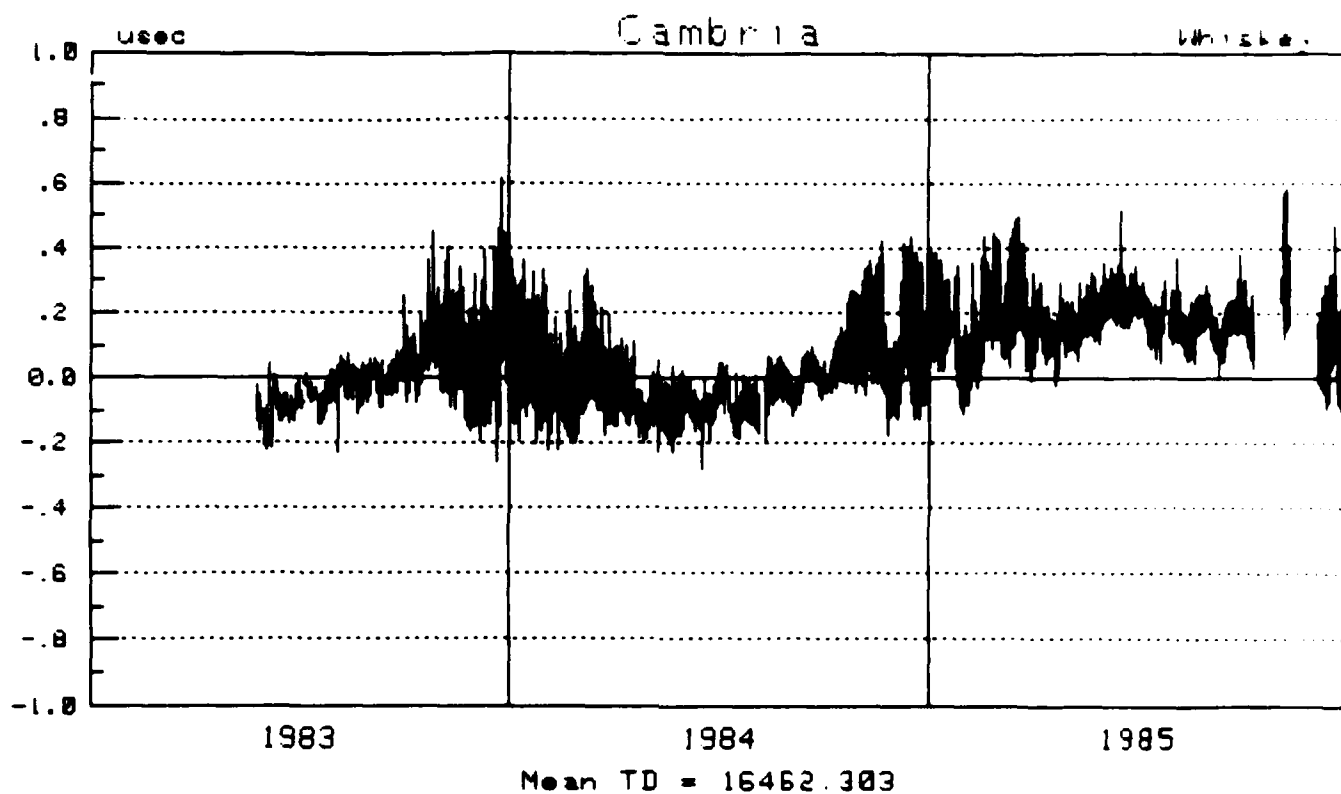
Receiving Antenna Location:

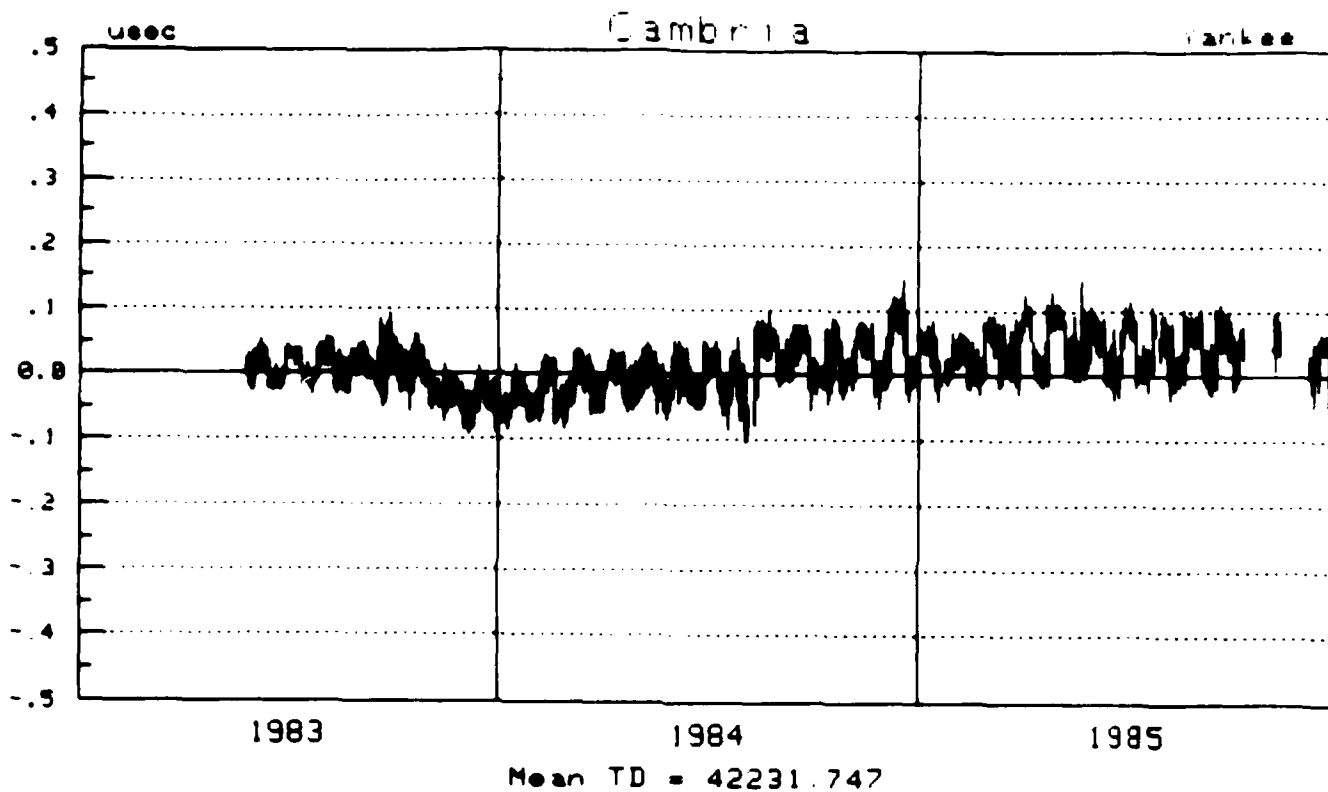
WGS 72
LAT : 35 31 6.28N
LON : 121 03 36.84W

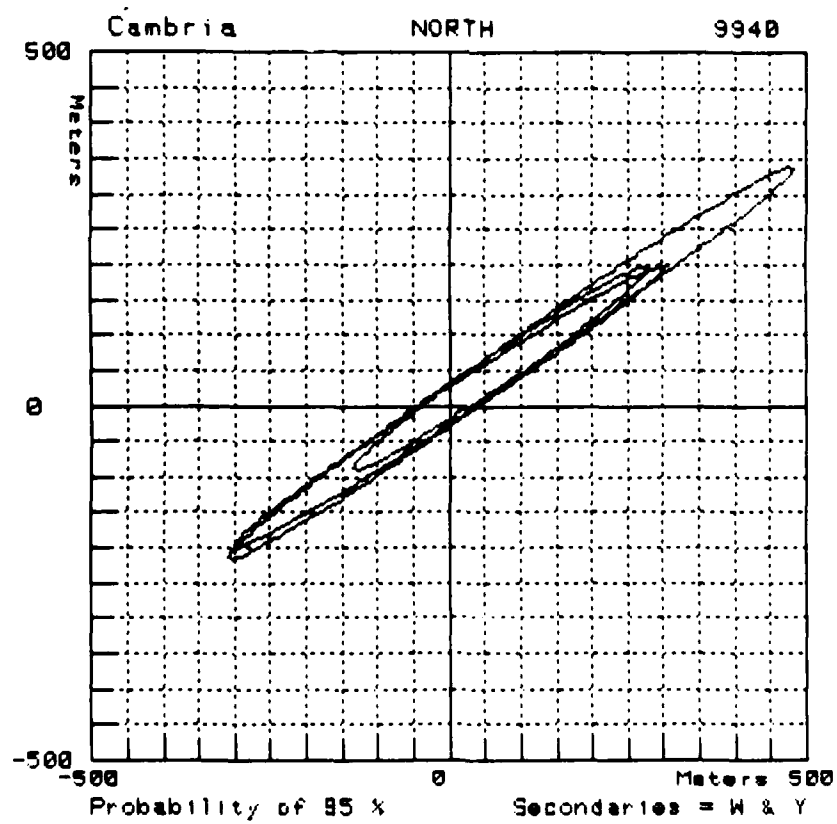
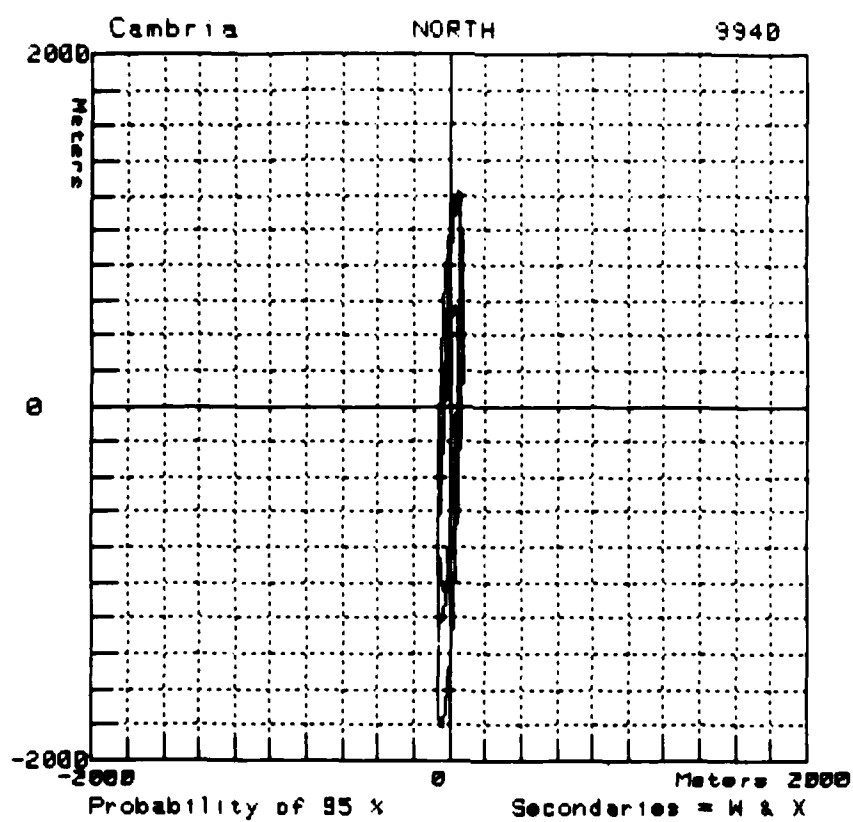
NAD 27
LAT : 35 31 6.61N
LON : 21 03 32.88W

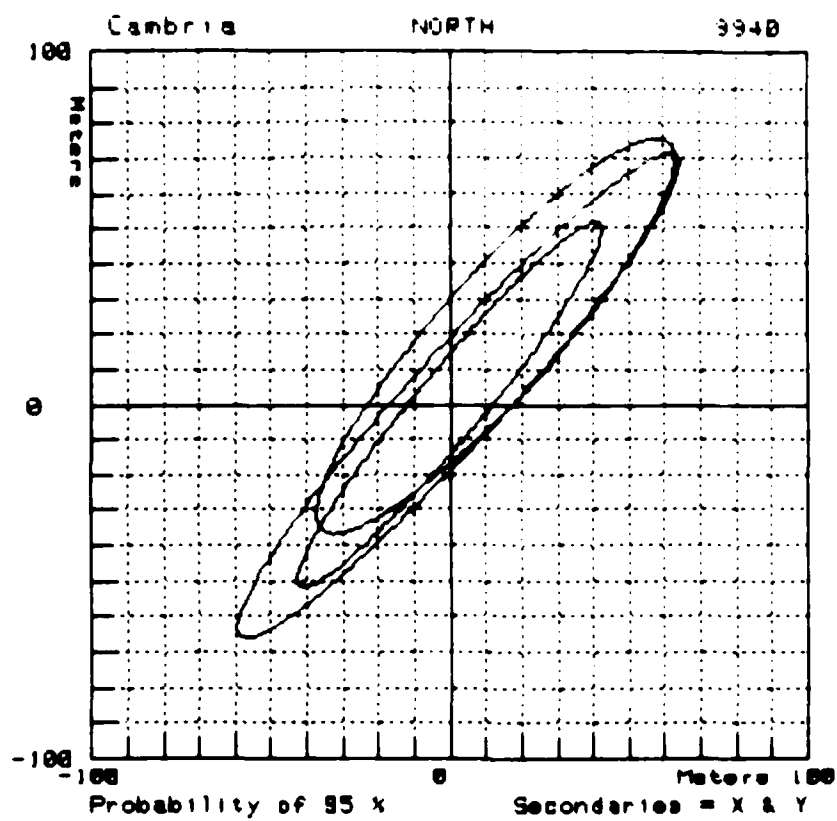
Positioning System
GPS

W-LOP: 13.7 deg	Gradients: 3055 ft/usec
X-LOP: 181.9 deg	Gradients: 1370 ft/usec
Y-LOP: 56.6 deg	Gradients: 886 ft/usec









HMS SITE INFORMATION

NORTH BEND, OREGON

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 10 Aug 1980 - 15 December 1984

GRI: 9940 U.S. West Coast Chain

TDW: 13513.979 A1 Control
TDX: 27801.497 A2
TDY: 43931.004 A2

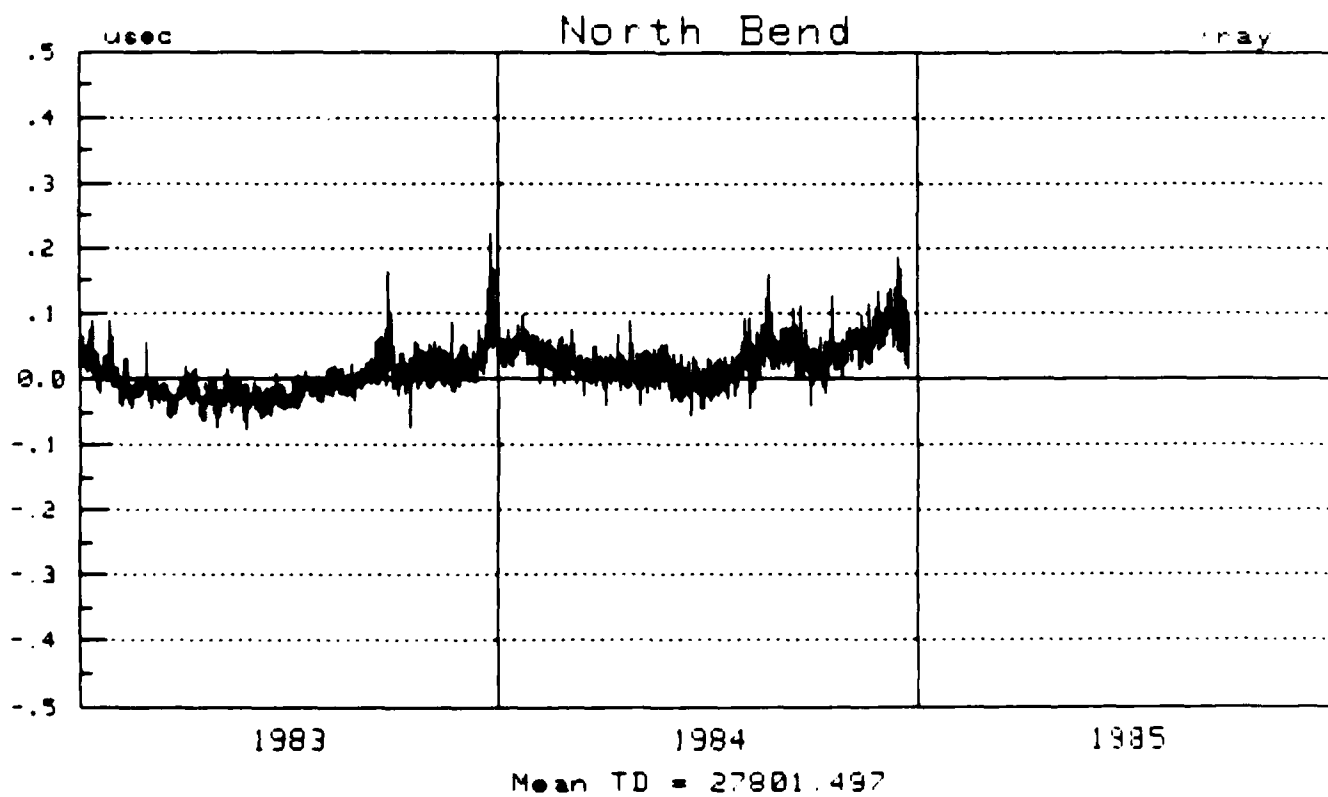
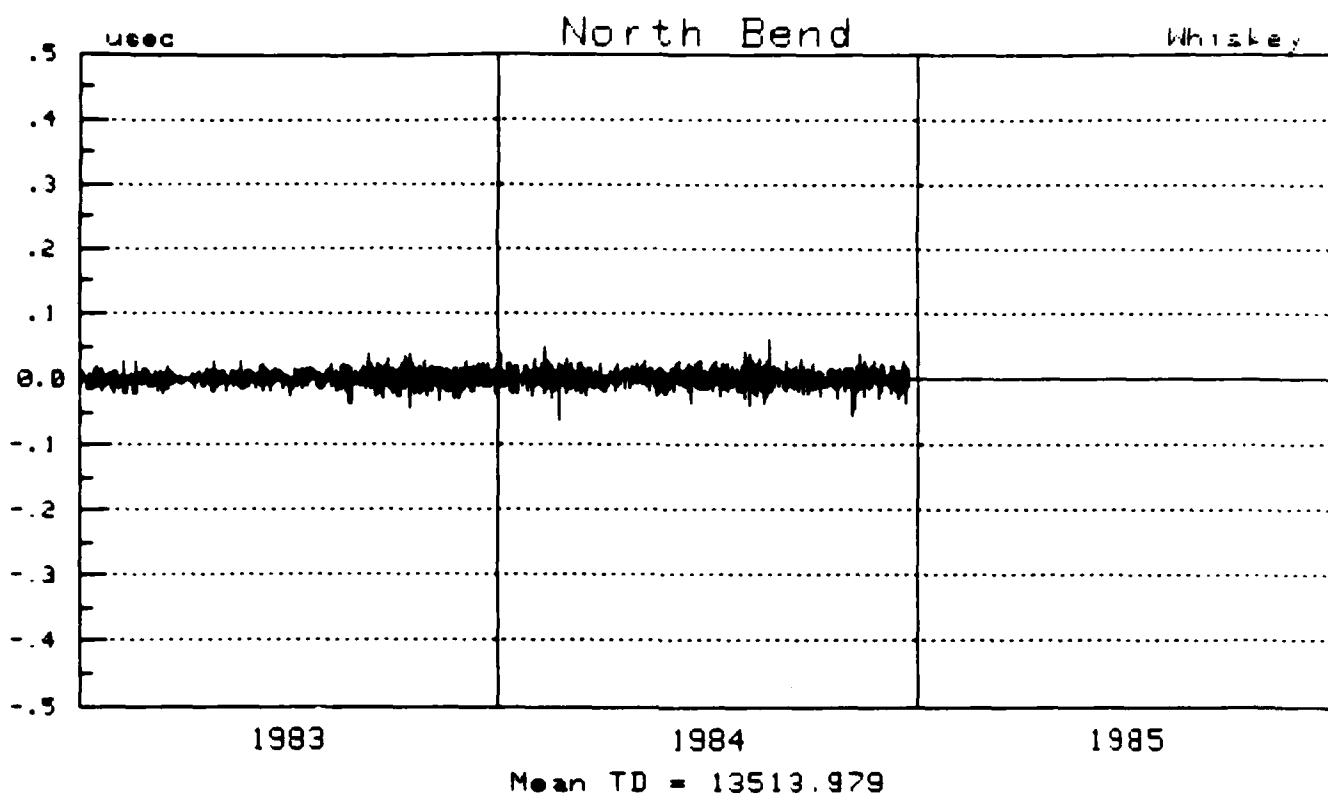
Receiving Antenna Location:

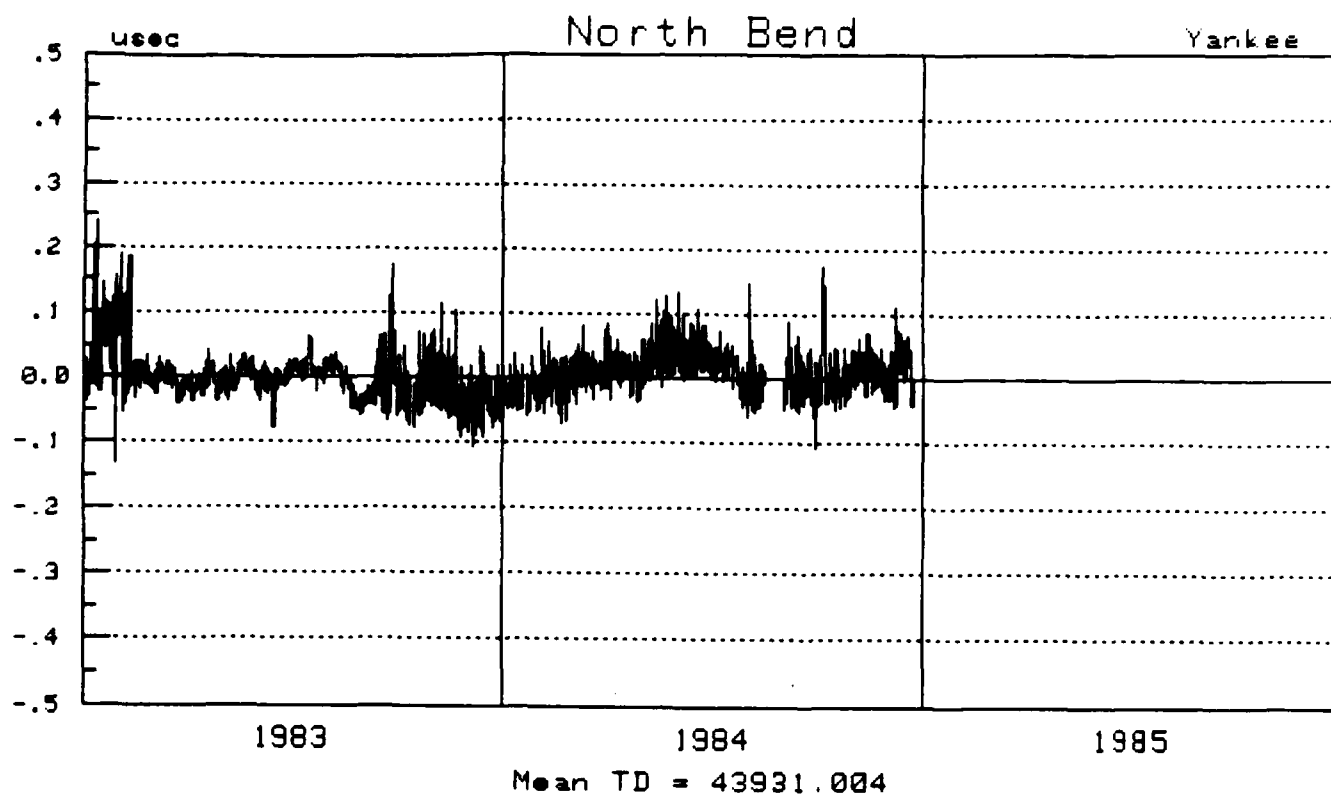
WGS 72
LAT : 43 24 36.7 N
LON : 124 14 28.19W

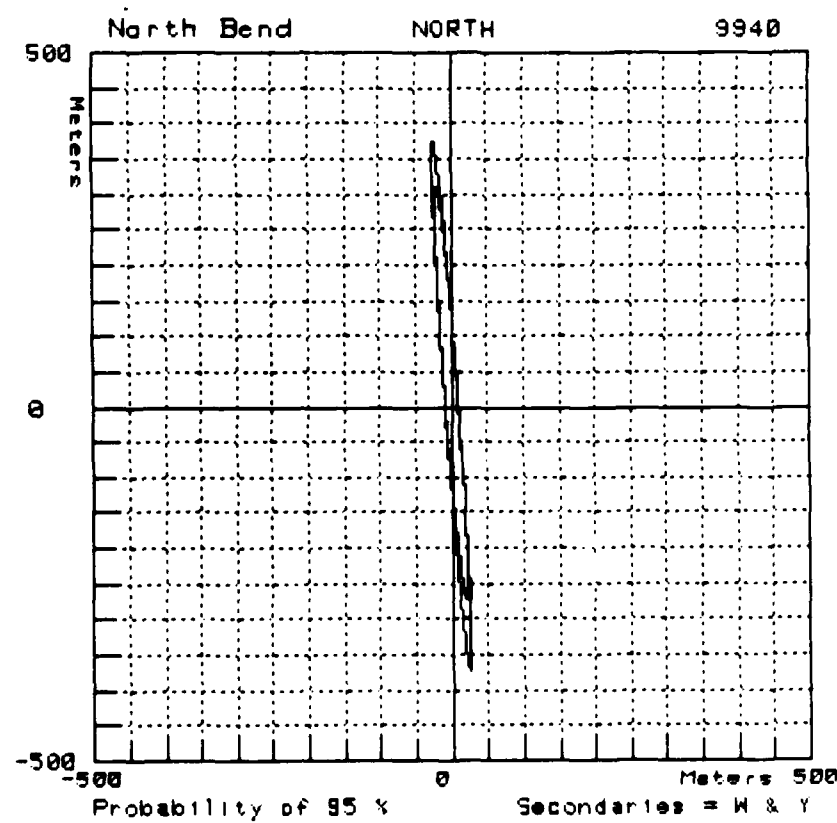
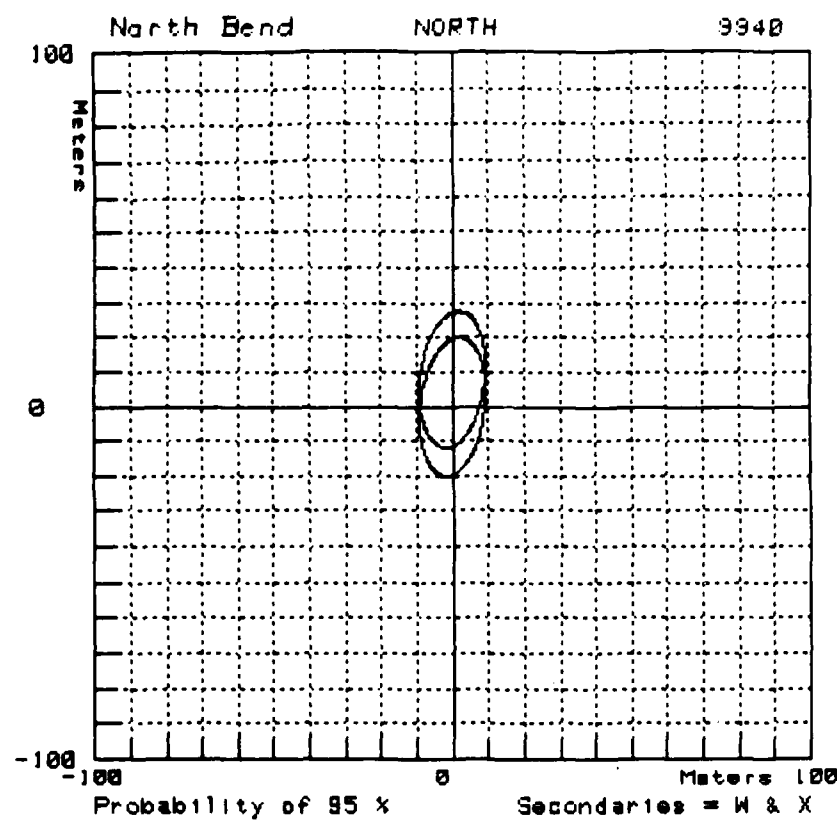
NAD 27
LAT : 43 24 37.65N
LON : 24 14 23.46W

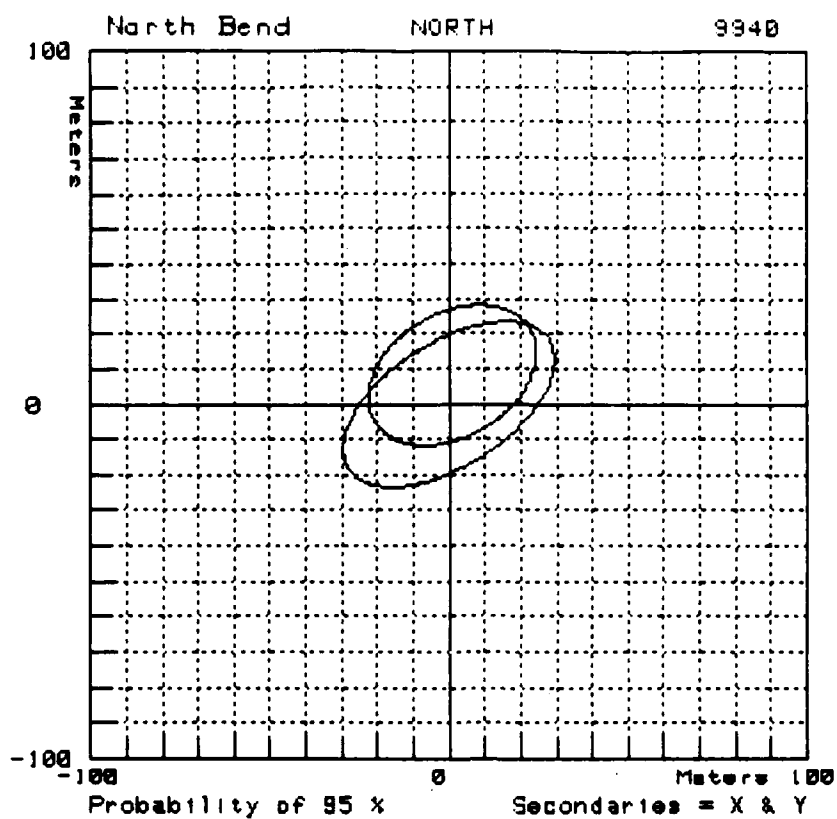
Positioning System
GPS

W-LOP: 85.6 deg Gradients: 682 ft/usec
X-LOP: 147.7 deg Gradients: 1793 ft/usec
Y-LOP: 133.3 deg Gradients: 18313 ft/usec









HMS SITE INFORMATION

POINT CABRILLO, CALIFORNIA

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 30 March 1985 - Present

GRI: 9940 U.S. West Coast Chain

TDW: 15428.143 A1 Control
TDX: 27094.230 A2
TDY: 43587.440 A2

Receiving Antenna Location:

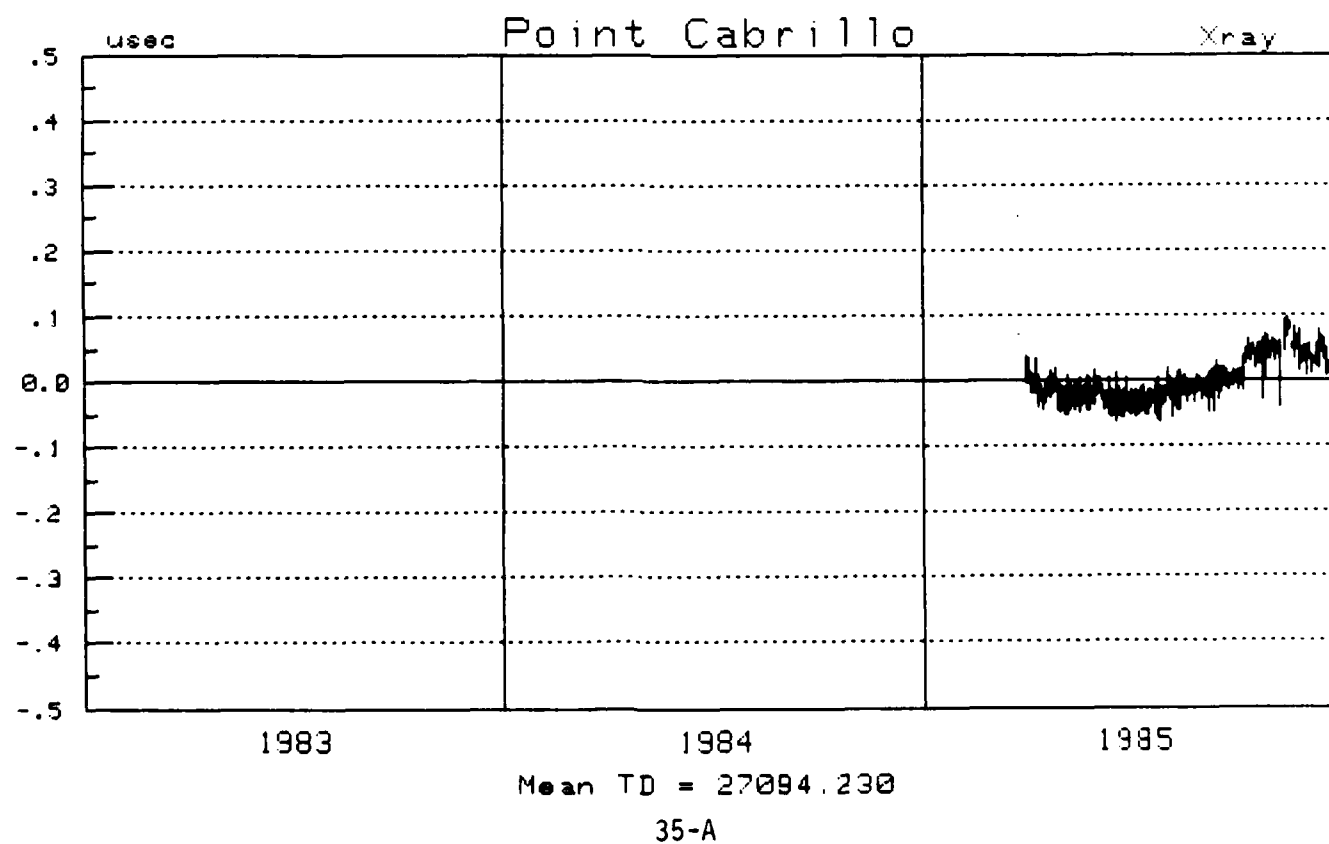
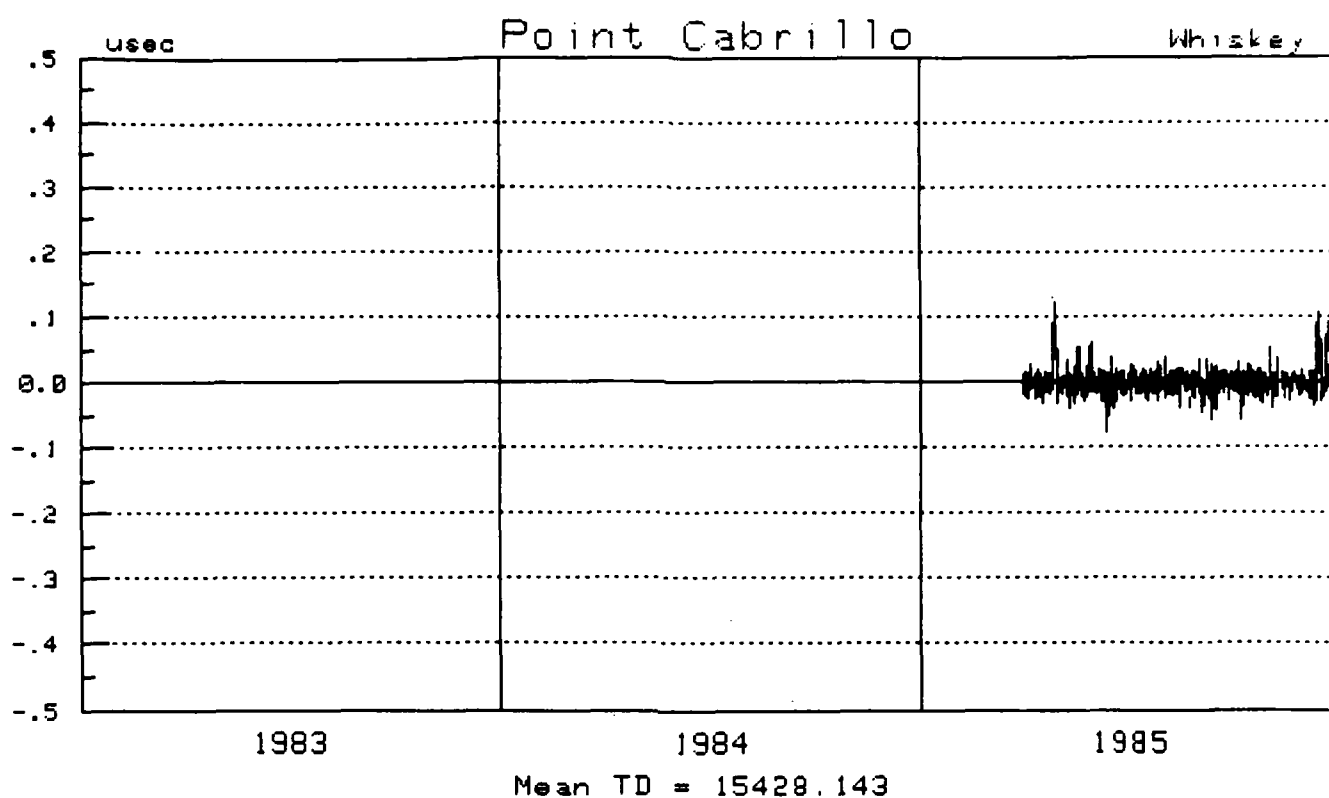
WGS 72
LAT : 39 20 55.94N
LON : 123 49 36.91W

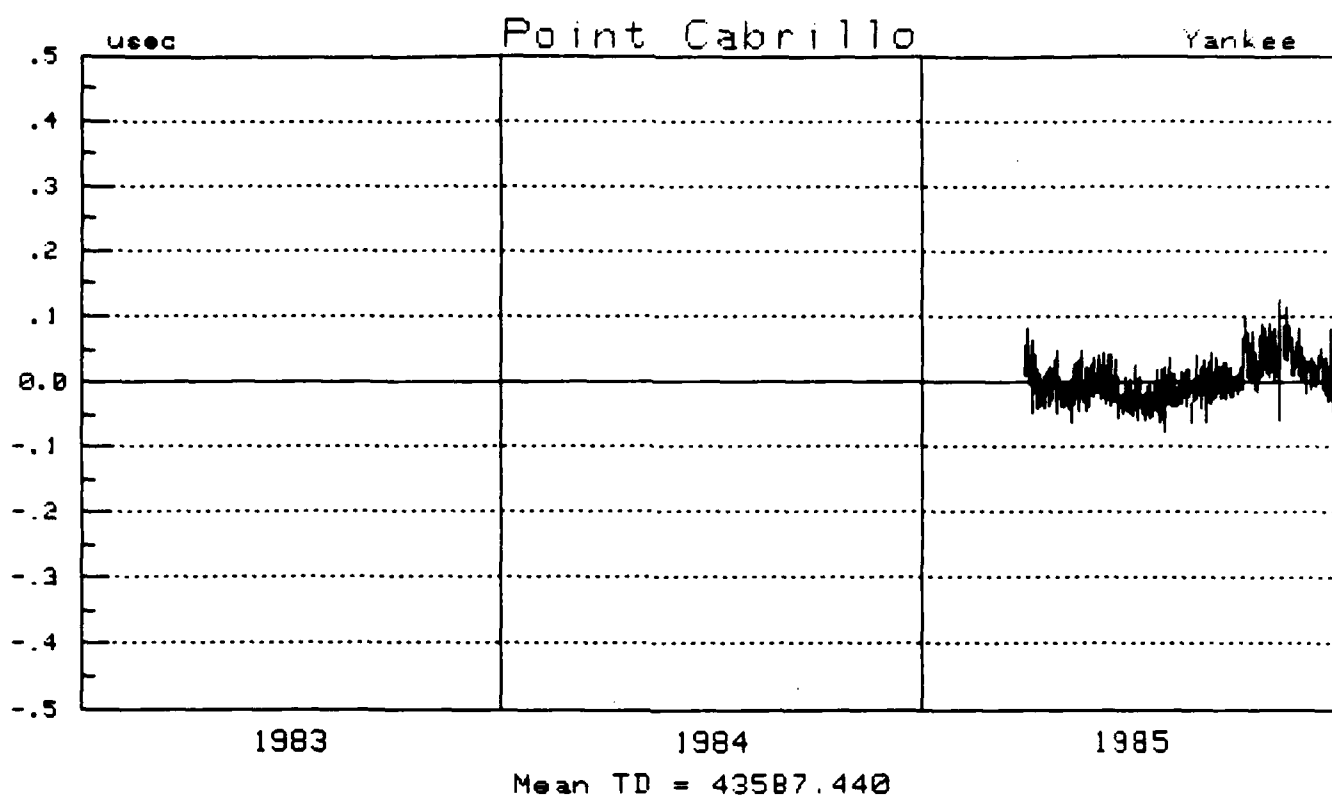
NAD 27
LAT : 39 20 56.66N
LON : 23 49 32.50W

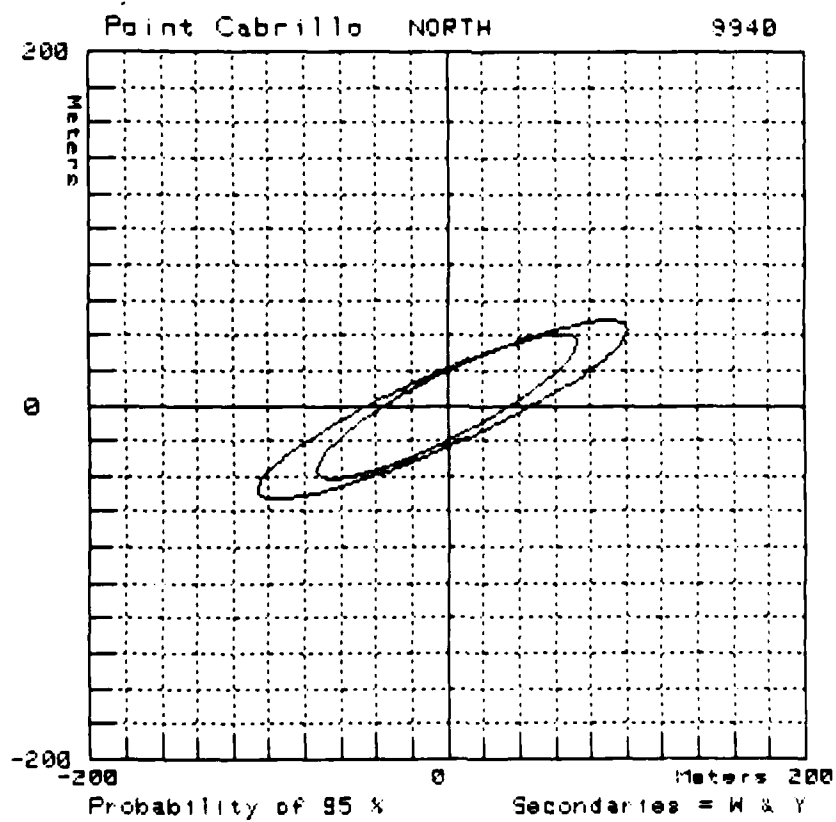
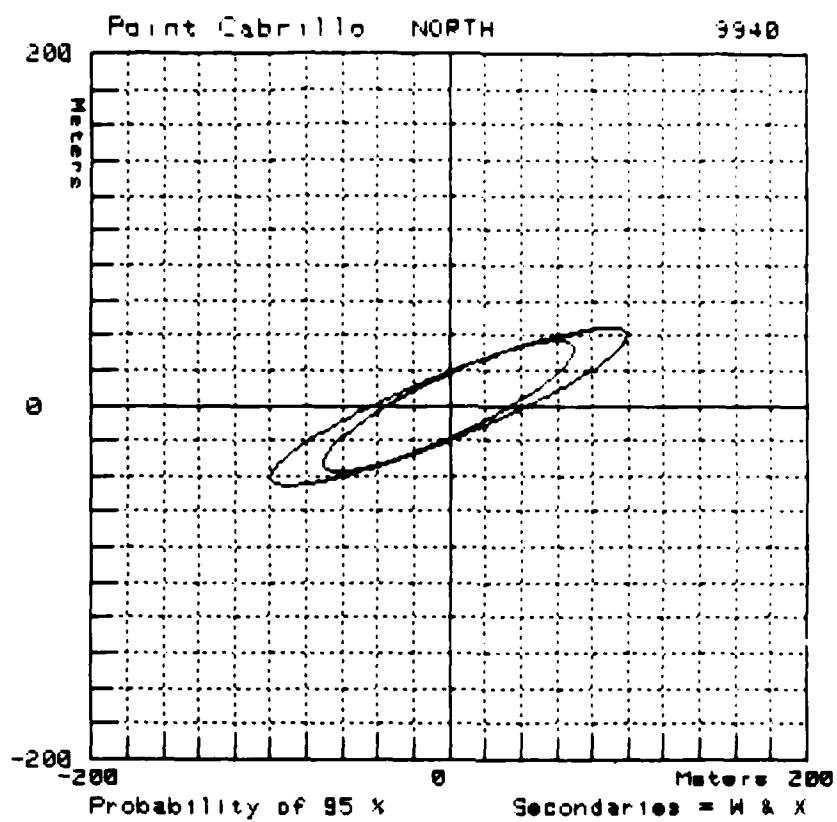
Positioning System
GPS

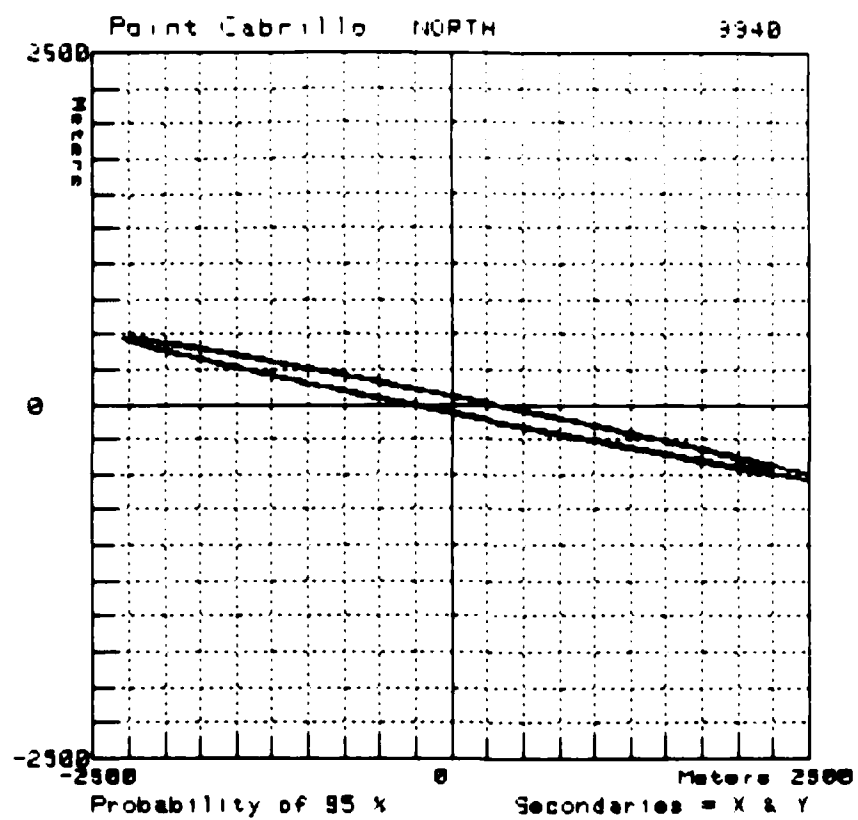
W-LOP: 52.6 deg
X-LOP: 101.9 deg
Y-LOP: 100.9 deg

Gradients: 907 ft/usec
Gradients: 1739 ft/usec
Gradients: 1839 ft/usec









HMS SITE INFORMATION

POINT PINOS, CALIFORNIA

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 10 August 1980 - Present

GRI: 9940 U.S. West Coast Chain

TDW: 16300.472 A2
TDX: 27494.290 A1 Control
TDY: 42756.060 A1 Control

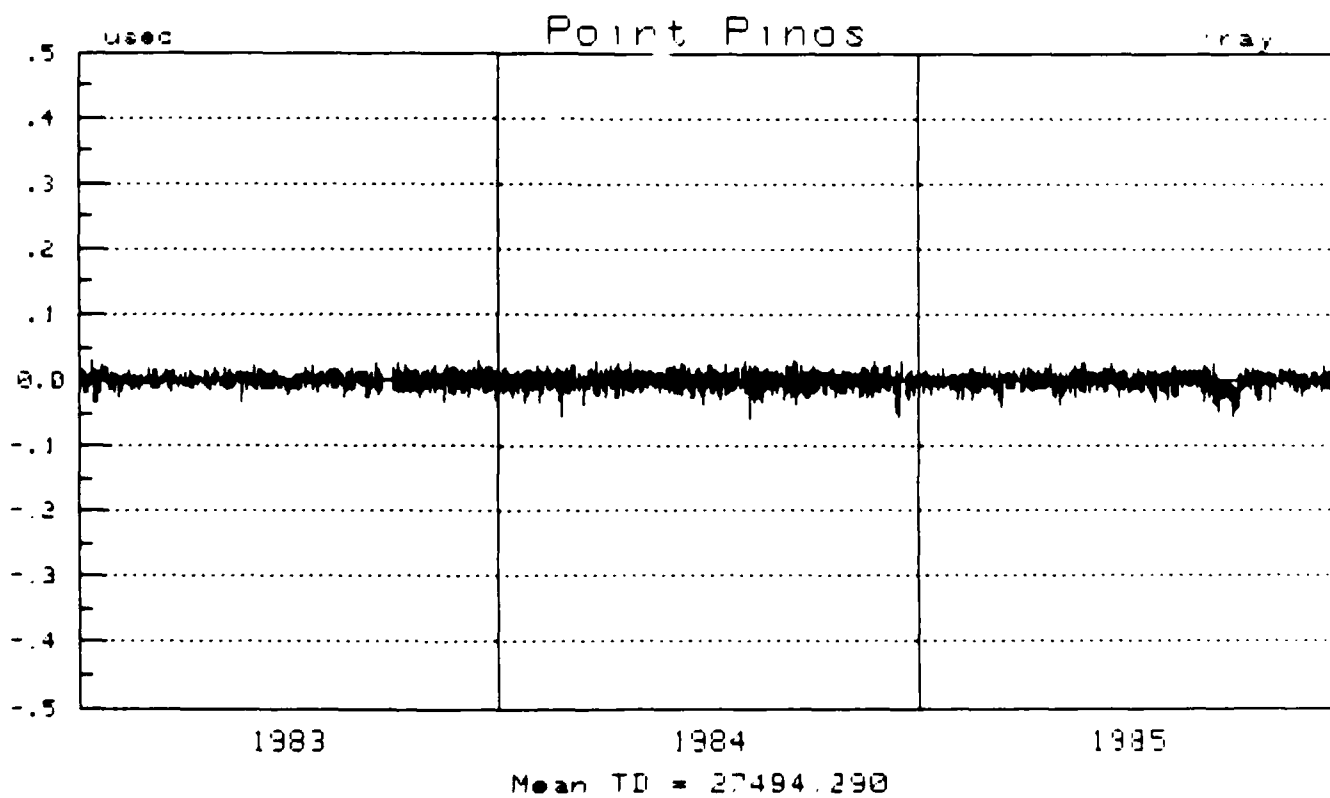
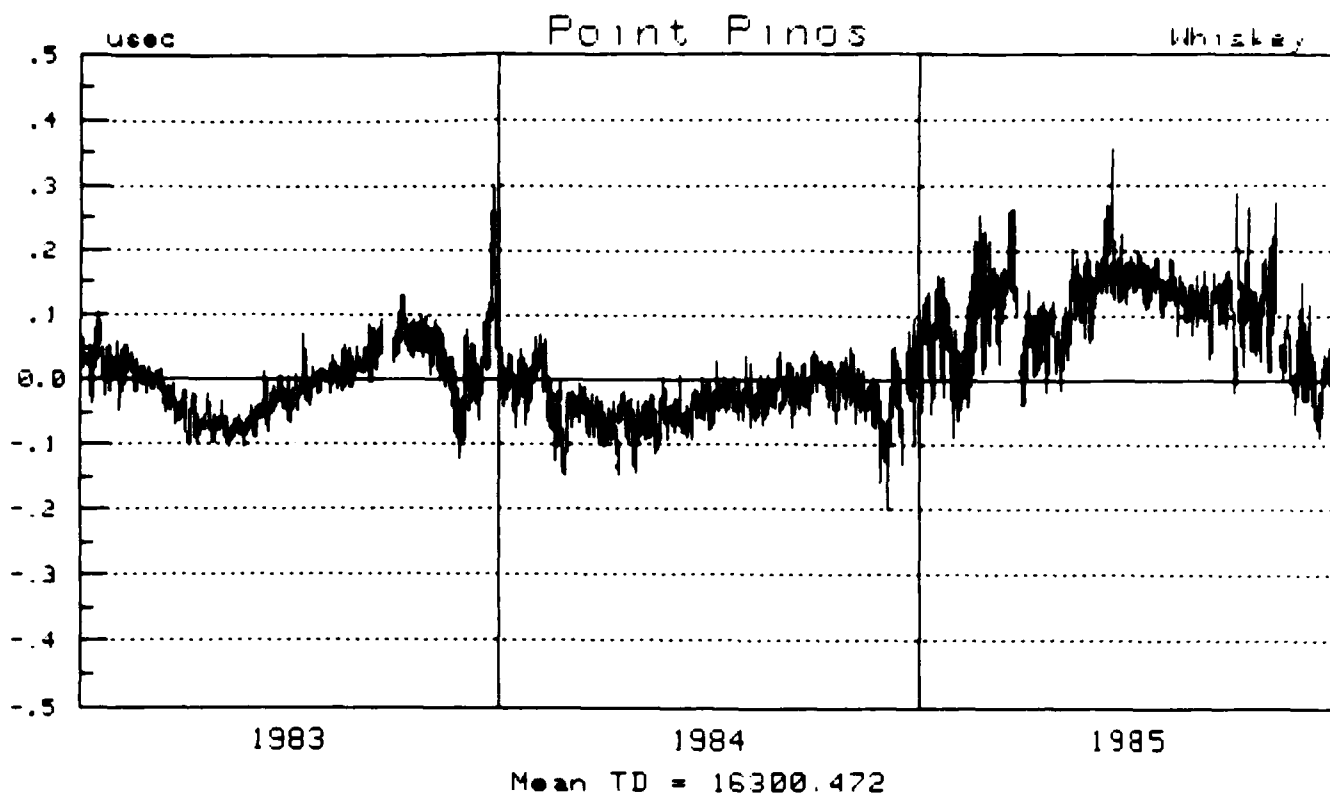
Receiving Antenna Location:

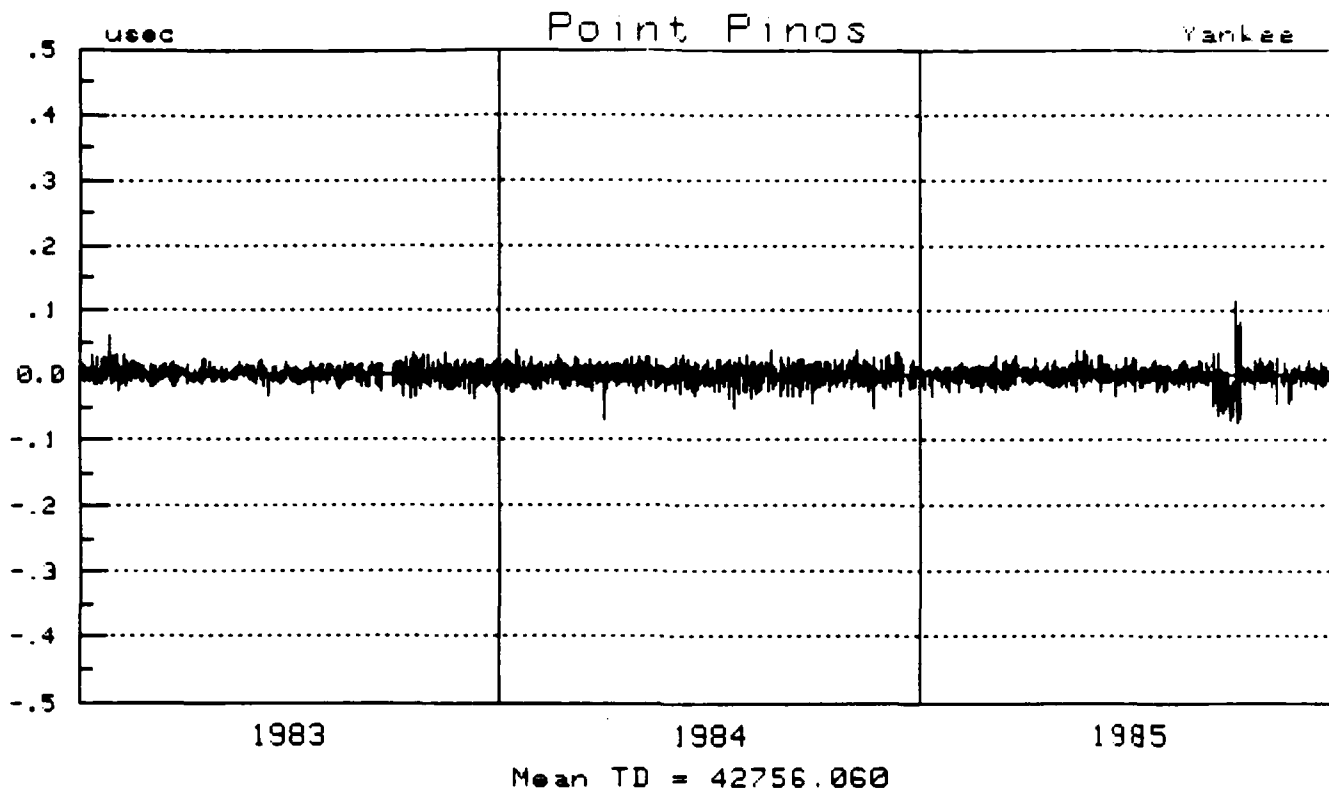
WGS 72
LAT : 36 37 59.14N
LON : 121 56 05.04W

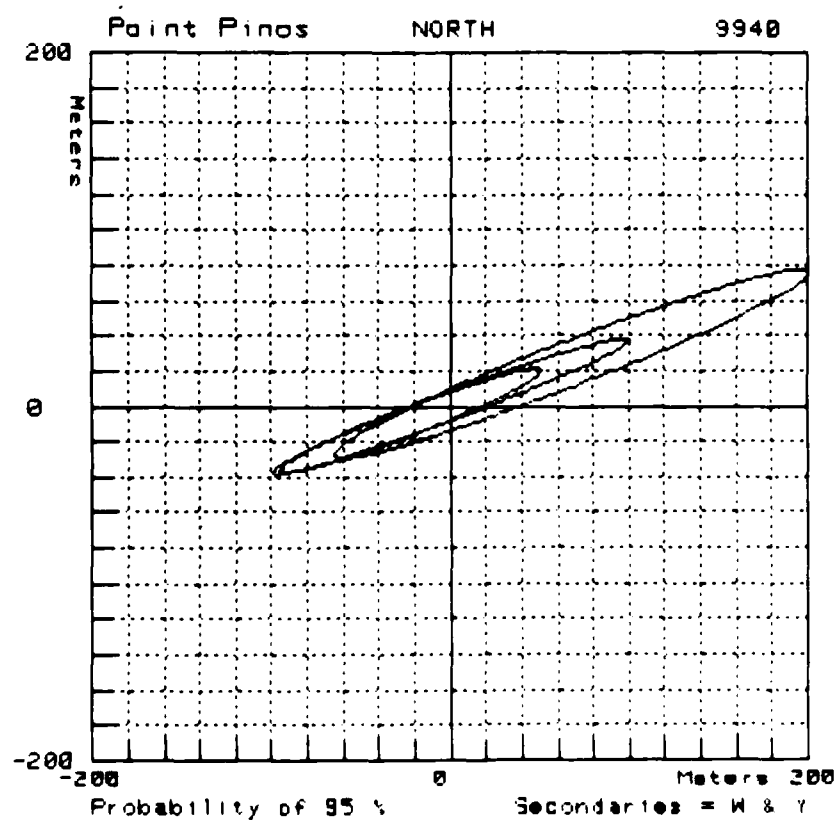
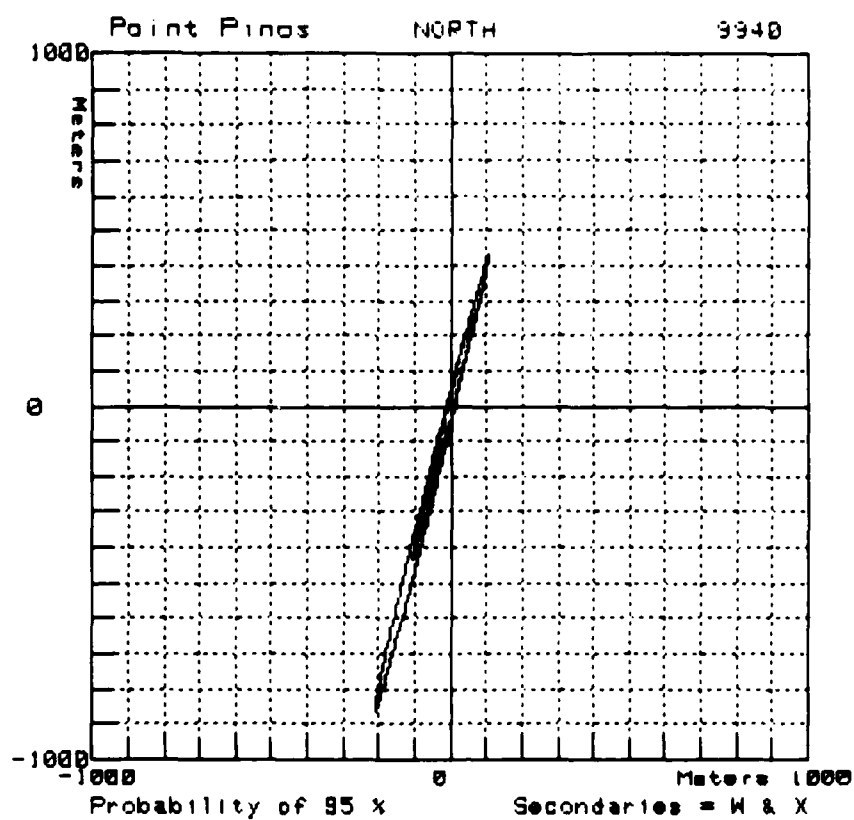
NAD 27
LAT : 36 37 59.59N
LON : 121 56 0.95W

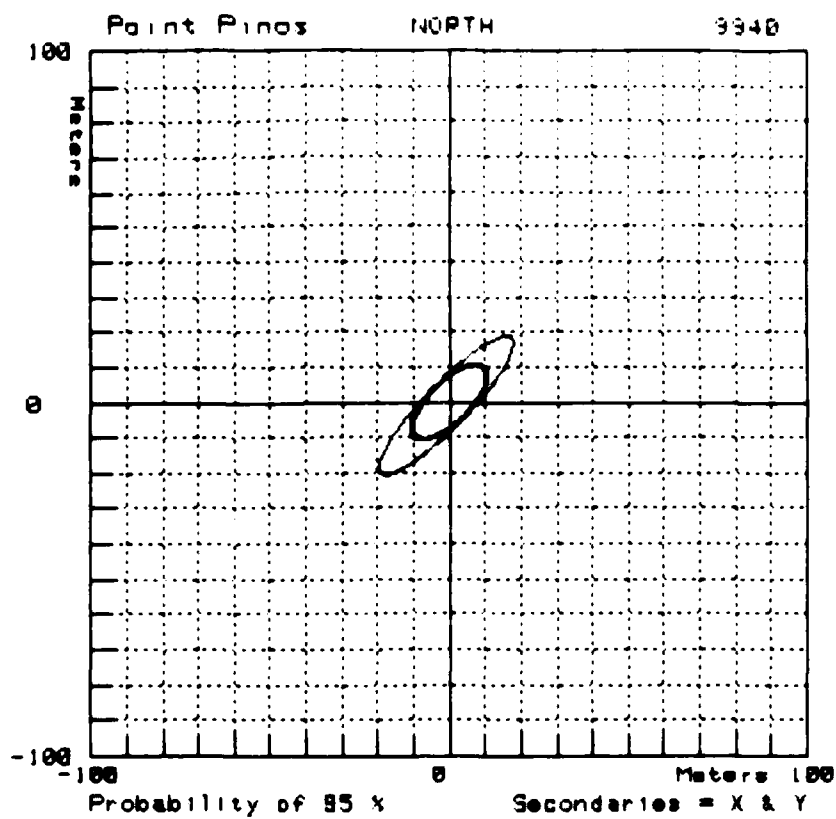
Positioning System
GPS

W-LOP: 23.6 deg Gradients: 1847 ft/usec
X-LOP: 193.7 deg Gradients: 1150 ft/usec
Y-LOP: 69.8 deg Gradients: 961 ft/usec









HMS SITE INFORMATION

POINT VICENTE (LOS ANGELES), CALIFORNIA

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 10 August 1982 - 20 March 1985

GRI: 9940 U.S. West Coast Chain

TDX: 28169.984
TDY: 41058.994

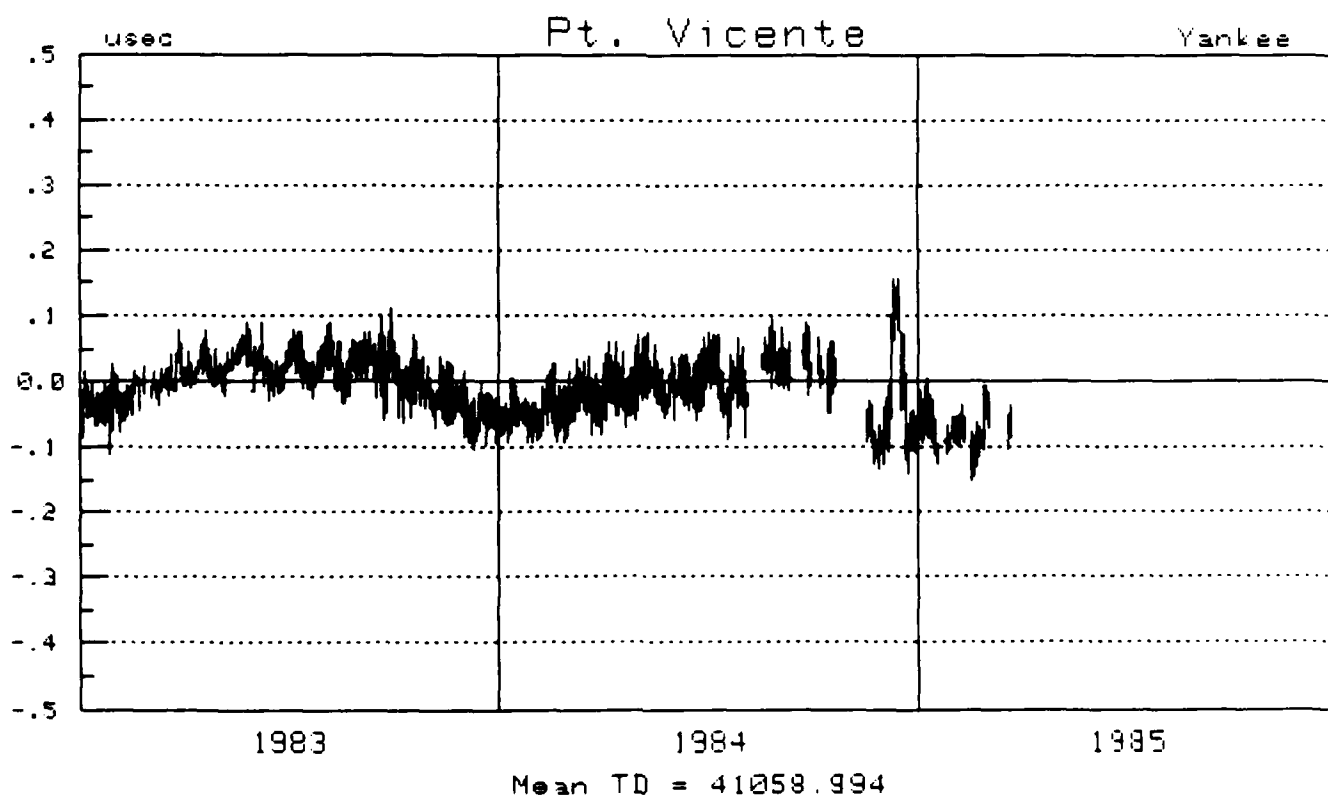
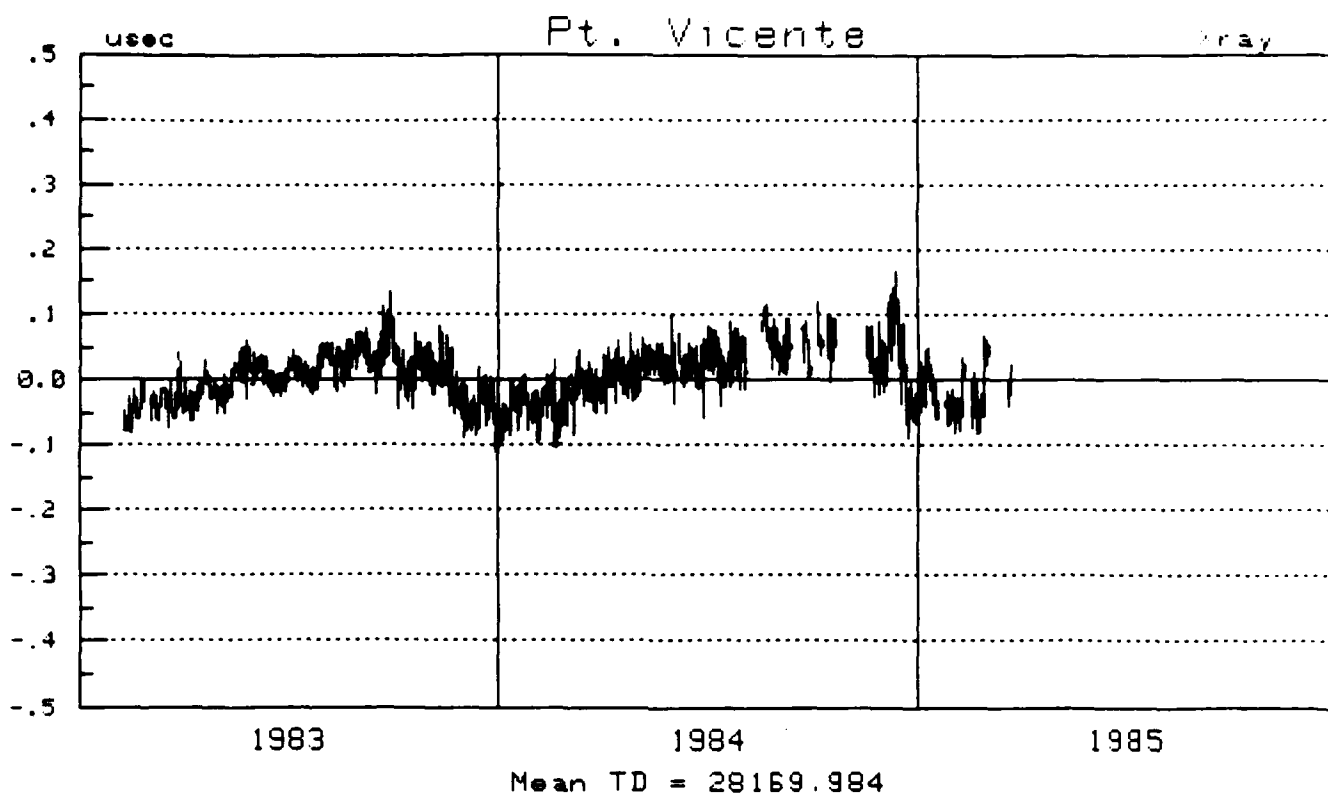
Receiving Antenna Location:

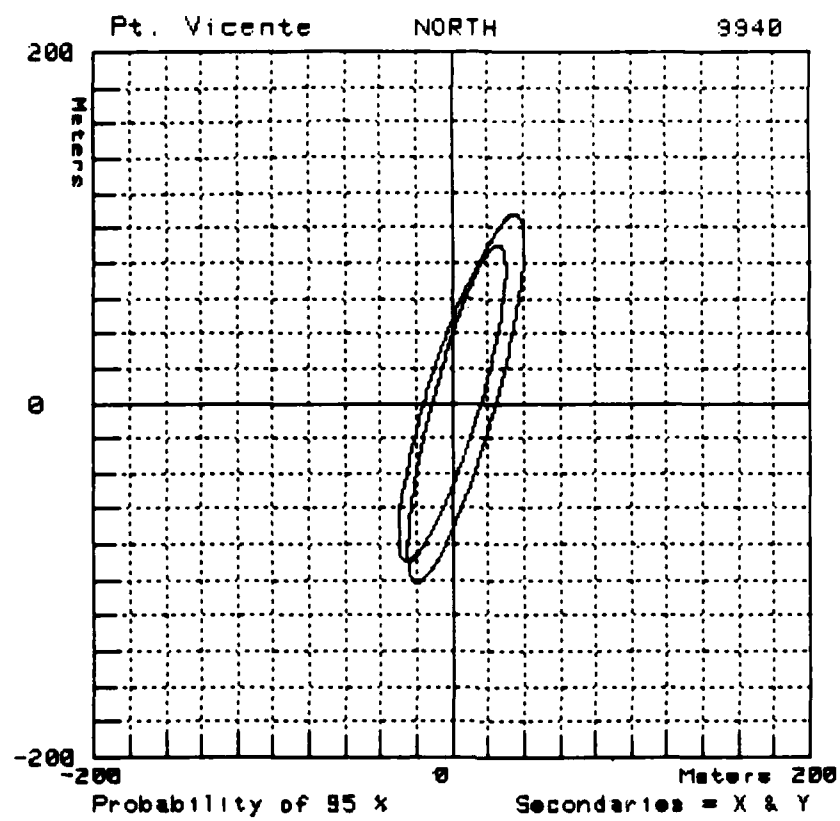
WGS 72
LAT : 33 44 31.72N
LON : 118 24 32.69W

NAD 27
LAT : 33 44 32.83N
LON : 118 24 38.21W

Positioning System
GPS

X-LOP: 342.4 deg Gradients: 1973 ft/usec
Y-LOP: 208.9 deg Gradients: 924 ft/usec





HMS SITE INFORMATION

SAN DIEGO, CALIFORNIA

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 03 March 1984 - 16 May 1985

GRI: 9940 U.S. West Coast Chain

TDX: 28264.715
TDY: 40607.500

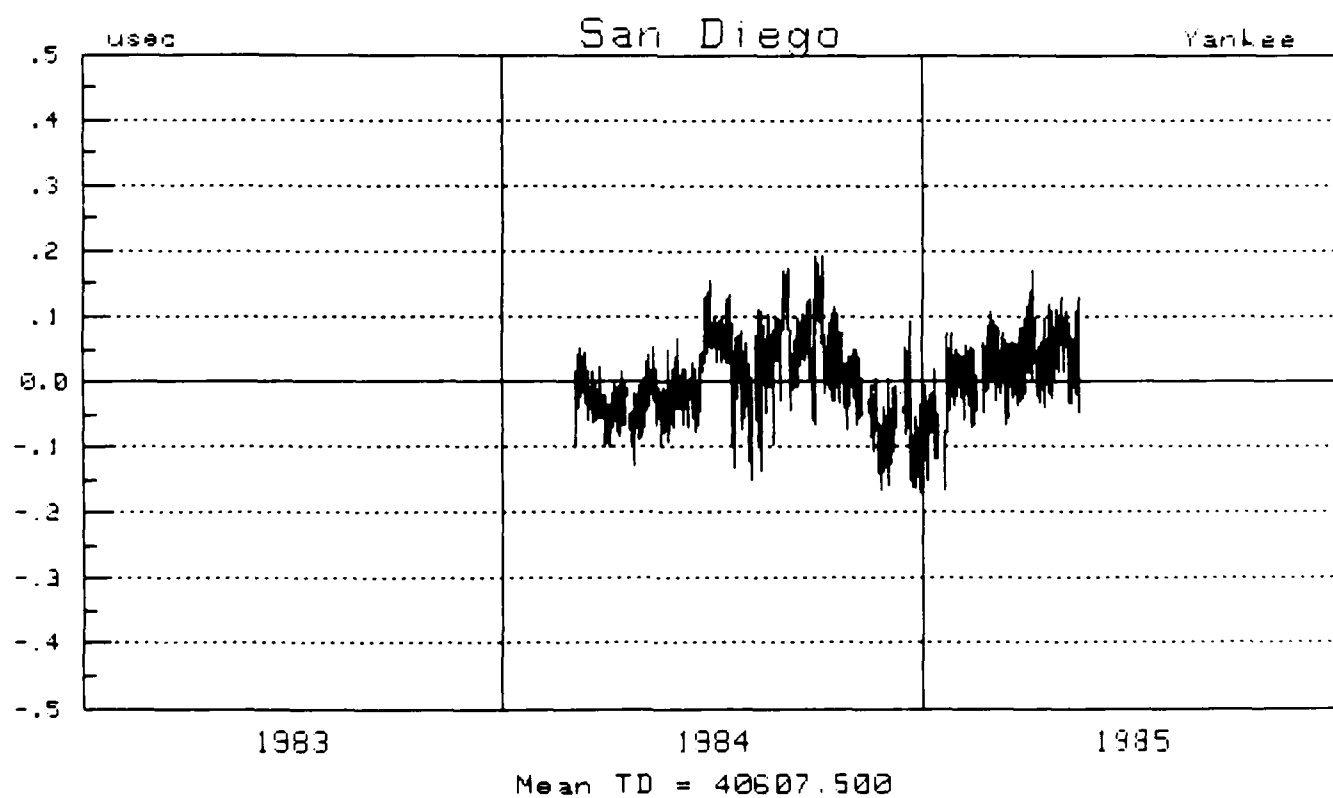
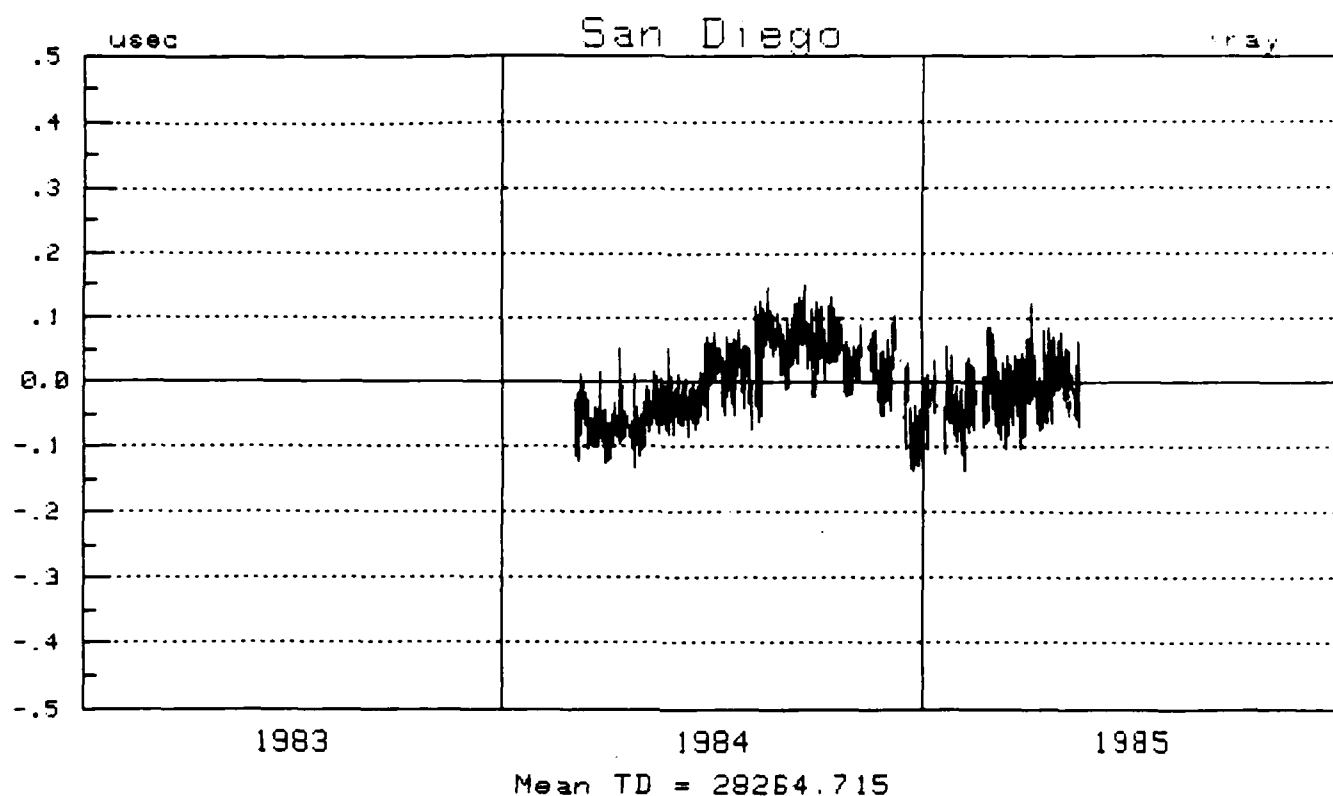
Receiving Antenna Location:

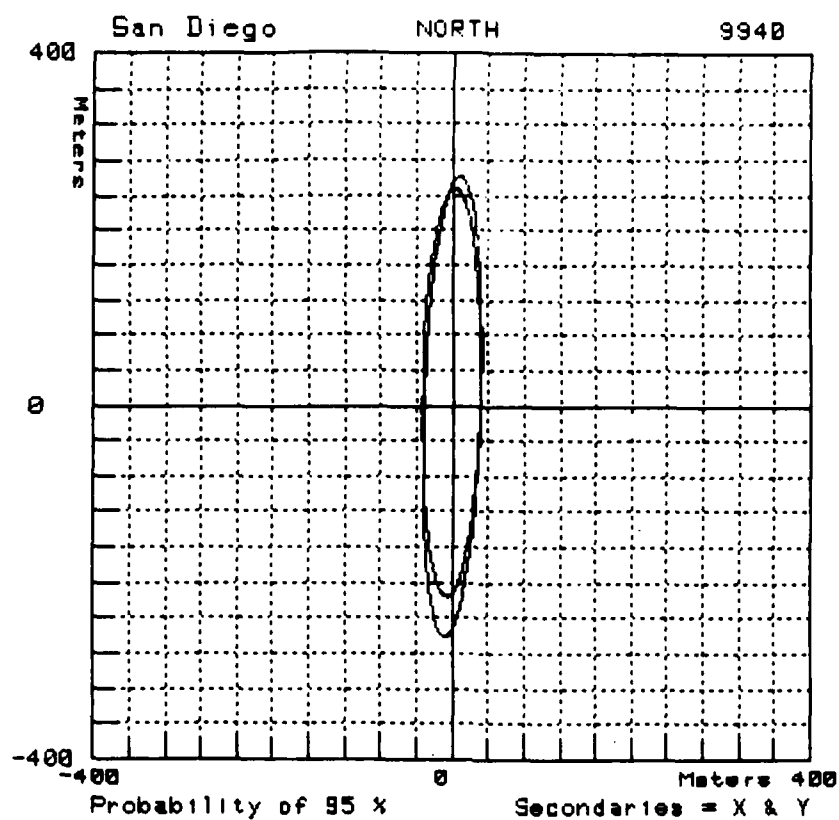
WGS 72
LAT : 32 41 8.27N
LON : 117 14 1.73W

NAD 27
LAT : 32 41 8.21N
LON : 117 13 58.22W

Positioning System
GPS

X-LOP: 338.0 deg Gradients: 2425 ft/usec
Y-LOP: 193.2 deg Gradients: 1231 ft/usec





HMS SITE INFORMATION

TIBURON (SAN FRANCISCO), CALIFORNIA

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 11 June 1984 - 20 January 1986

GRI: 9940 U.S. West Coast Chain

TDW: 16062.567
TDX: 27207.433
TDY: 43224.600

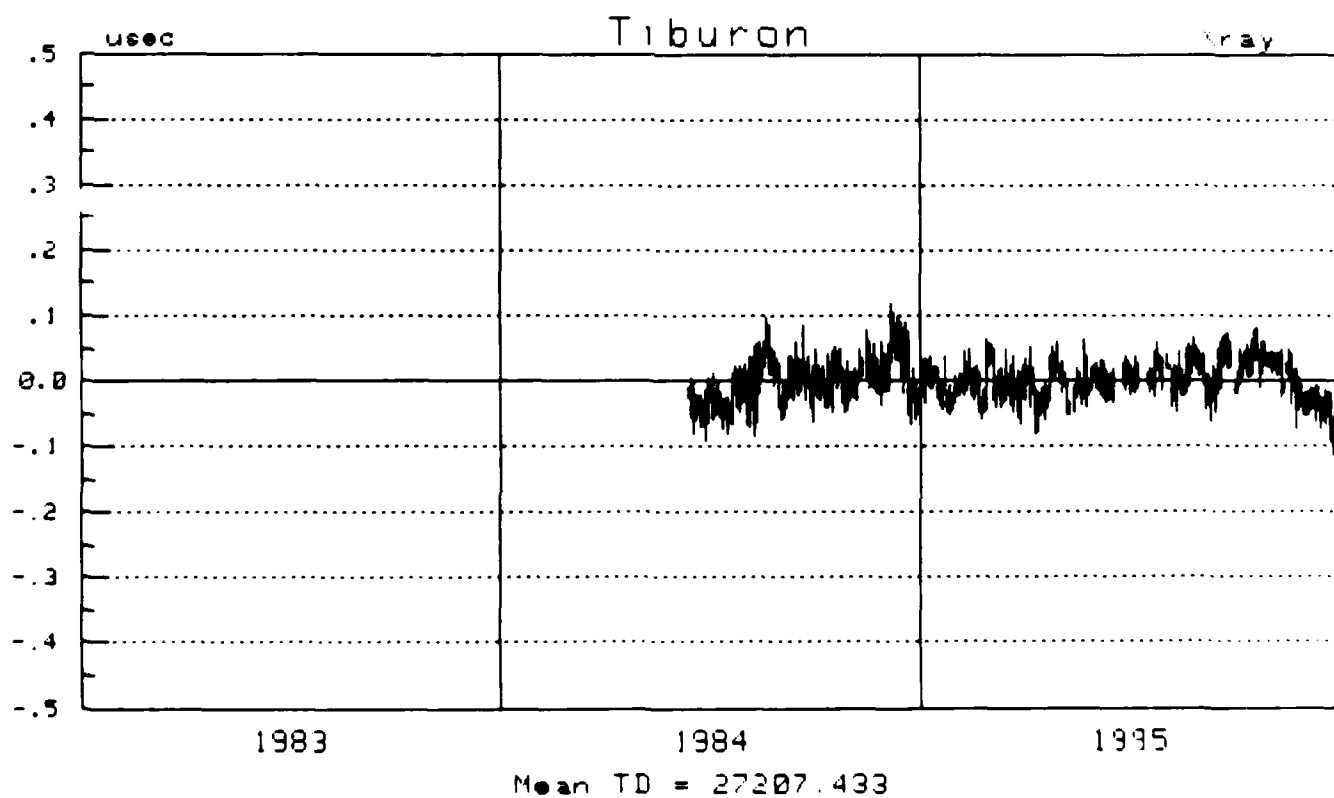
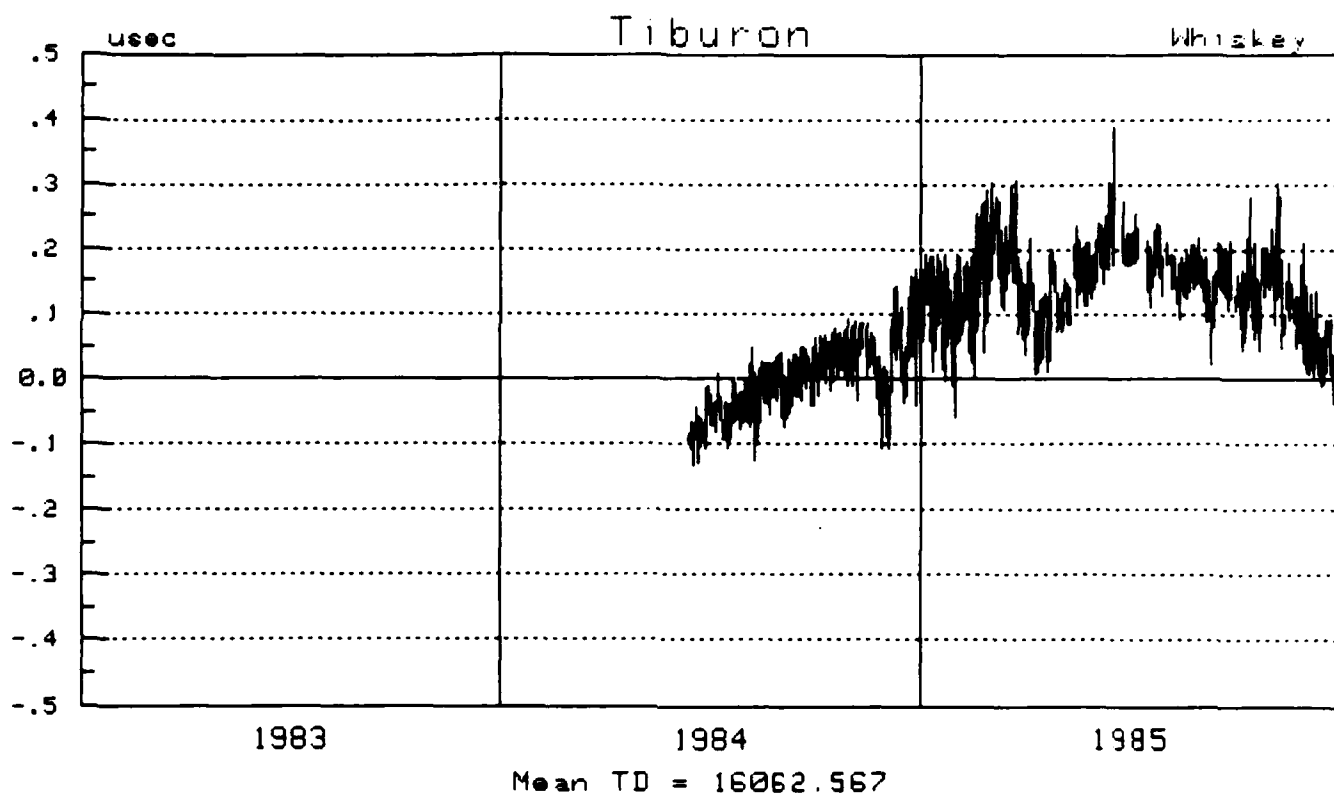
Receiving Antenna Location:

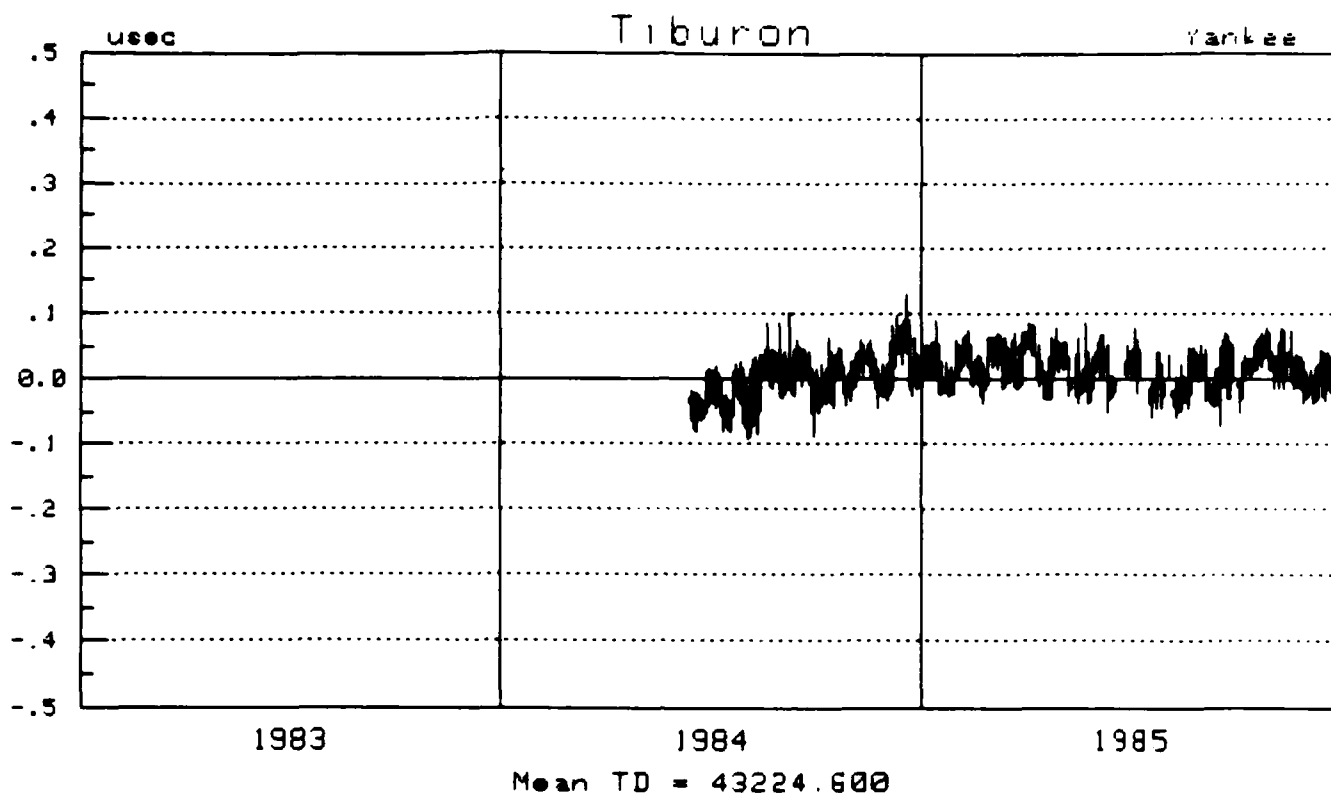
WGS 72
LAT : 37 53 30.91N
LON : 122 26 50.45W

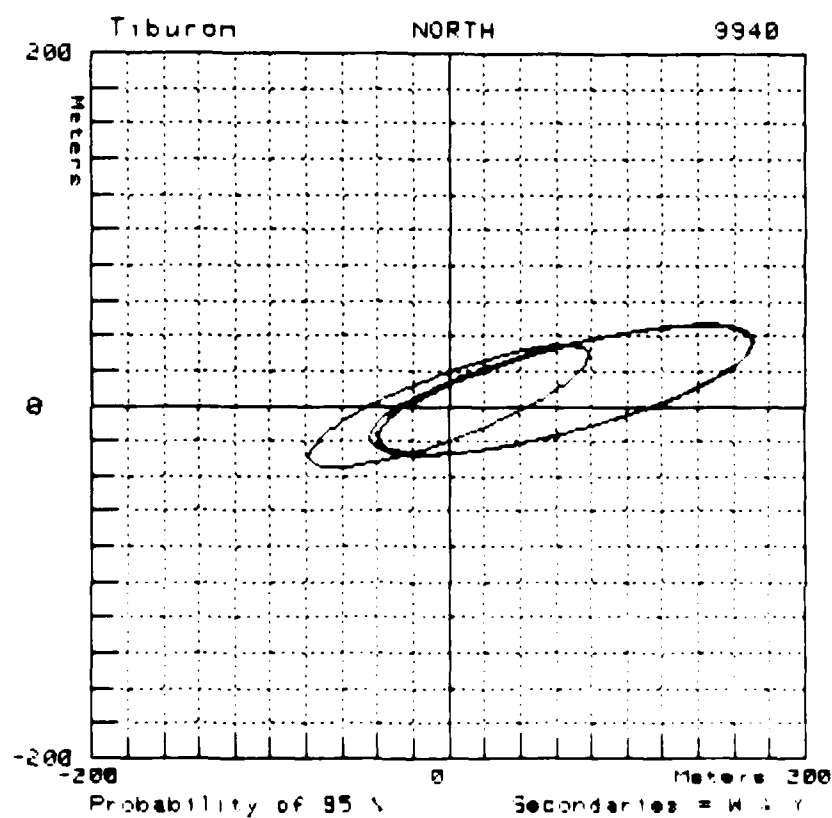
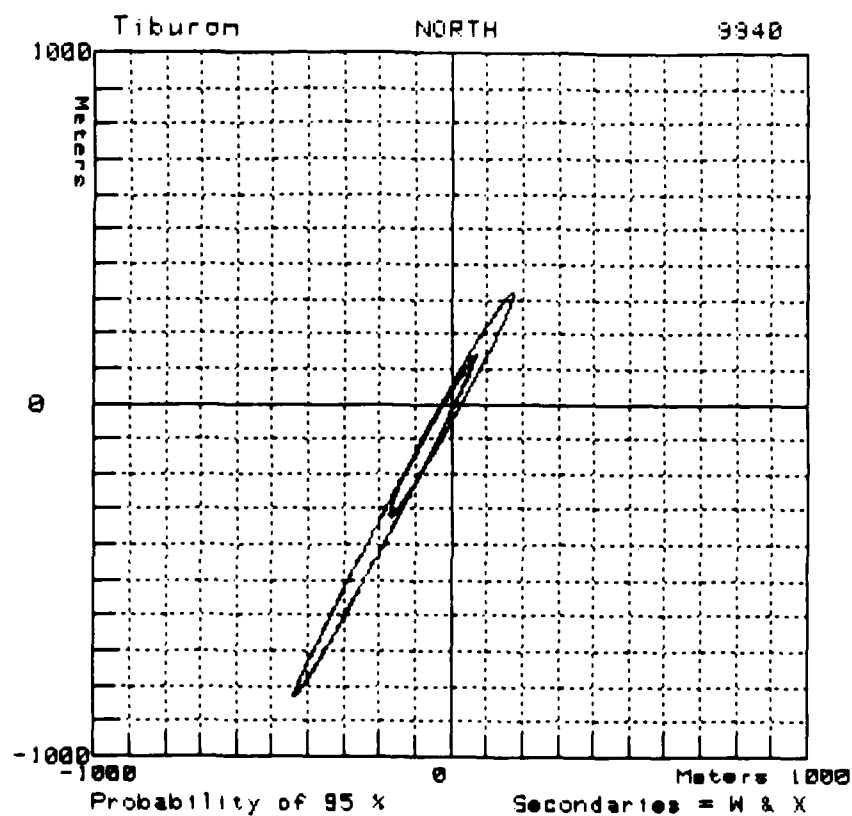
NAD 27
LAT : 37 53 31.48N
LON : 122 26 46.24W

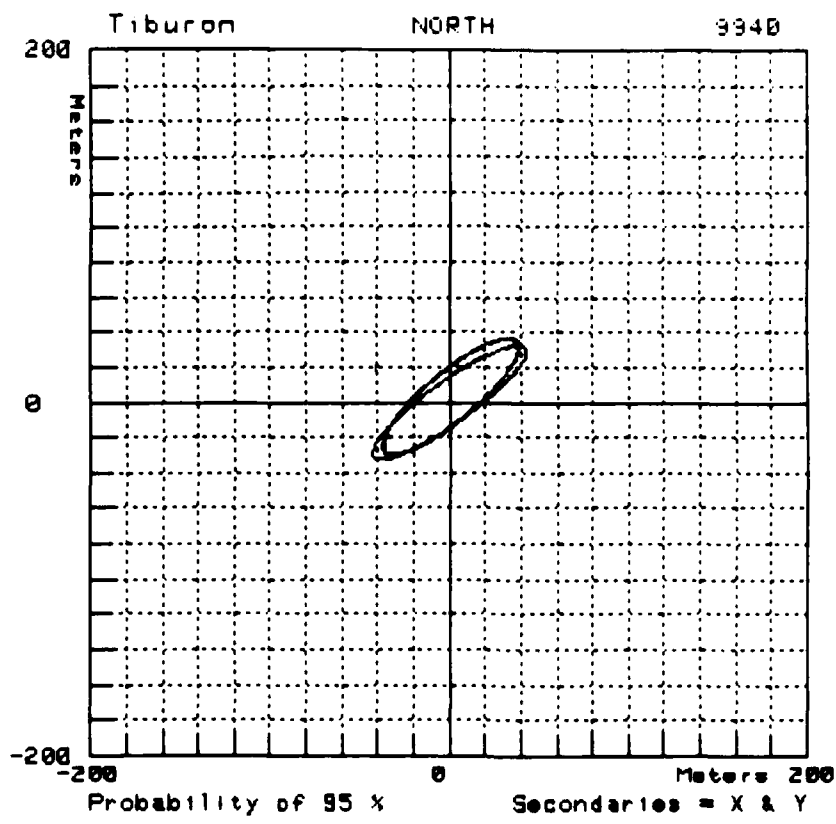
Positioning System
GPS

W-LOP: 34.9 deg Gradients: 1230 ft/usec
X-LOP: 28.0 deg Gradients: 968 ft/usec
Y-LOP: 84.4 deg Gradients: 1124 ft/usec









HMS SITE INFORMATION

ALEXANDRIA BAY, NEW YORK

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 14 September 1982 - 23 August 1984

GRI: 9960 U.S. Northeast Chain

TDW: 15431.164
TDX: 28312.222
TDZ: 60109.470

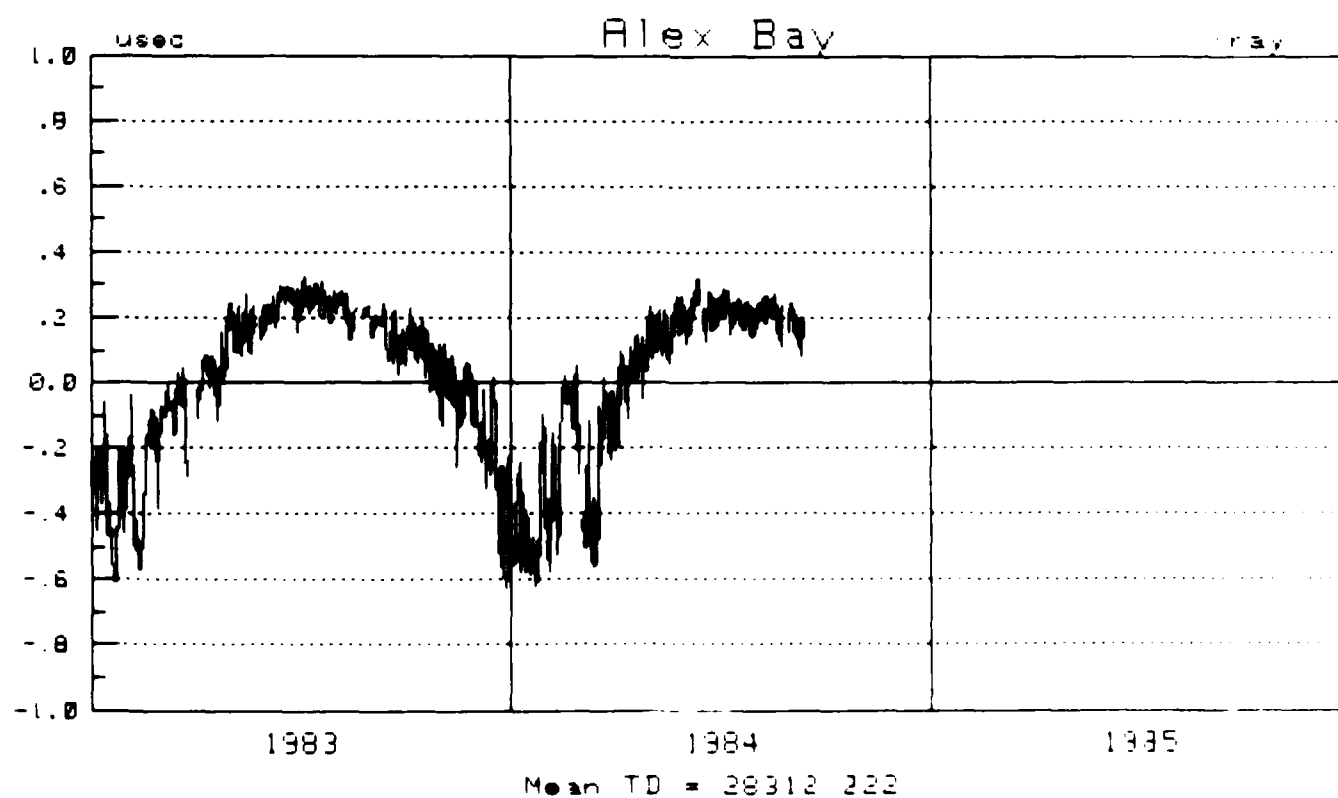
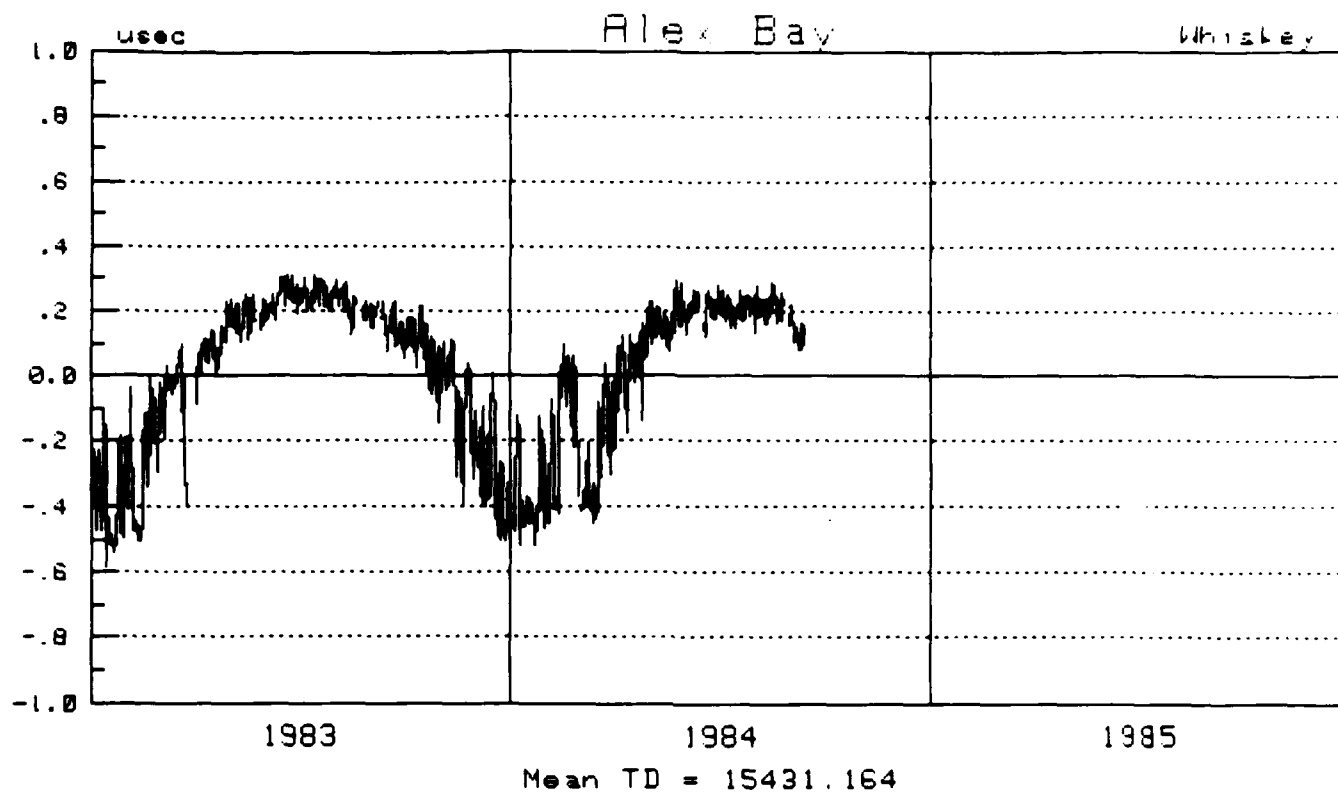
Receiving Antenna Location:

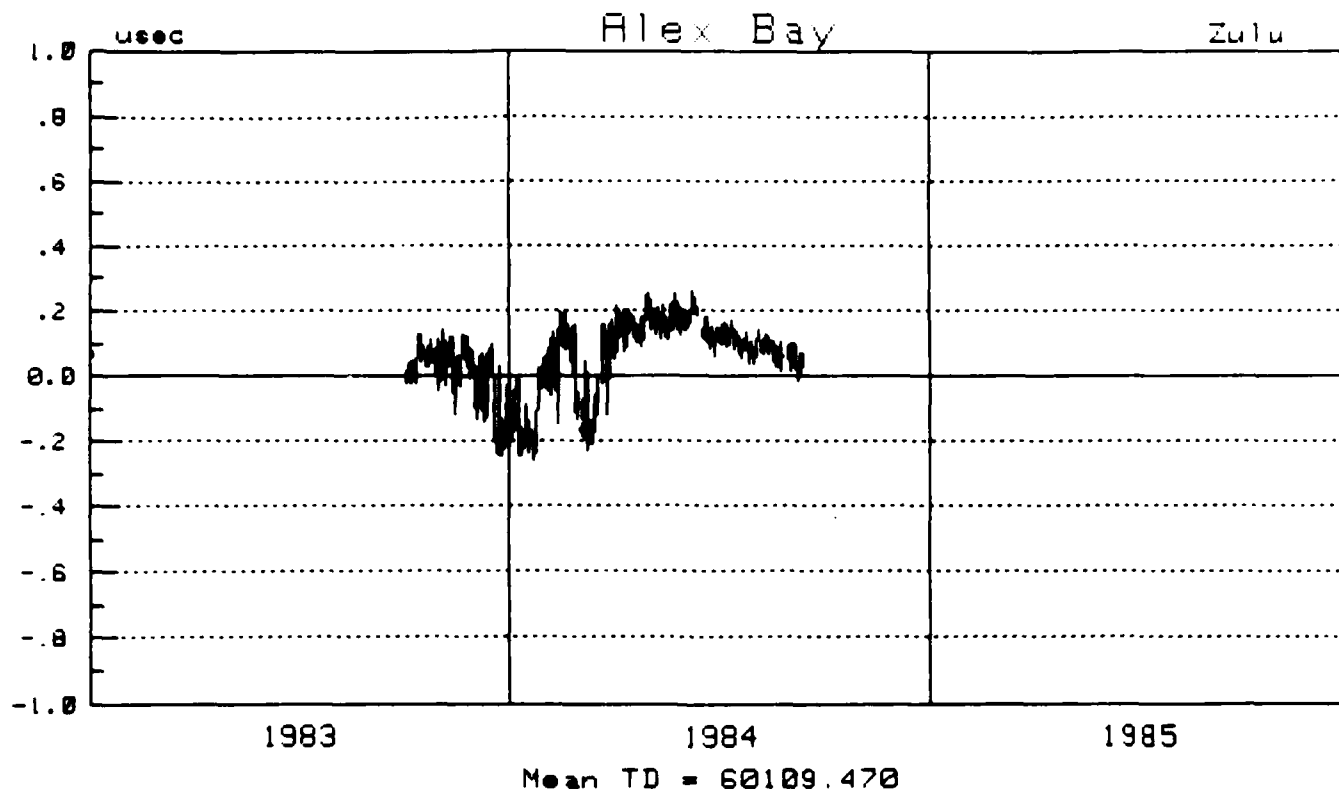
WGS 72
LAT : 44 19 49.9N
LON : 75 56 3.2W

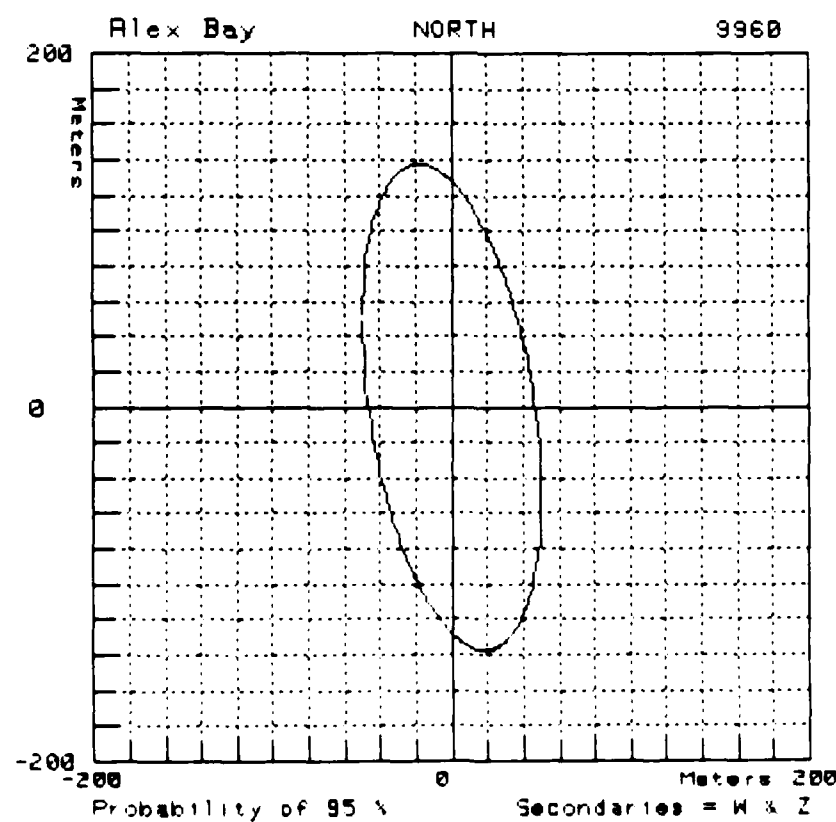
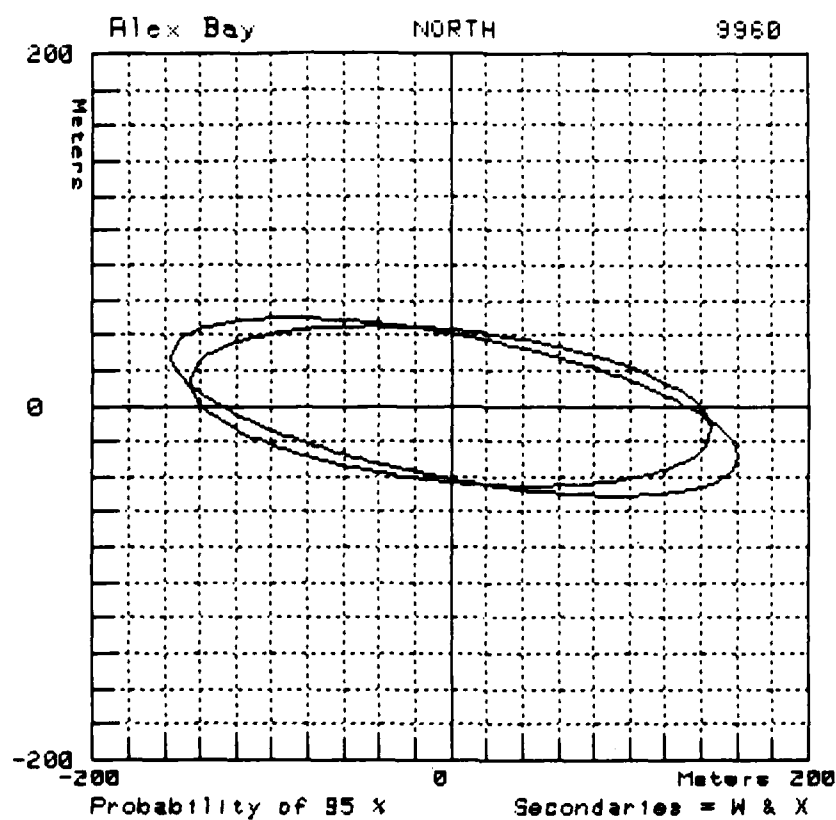
NAD 27
LAT : 44 19 50N
LON : 75 56 04W

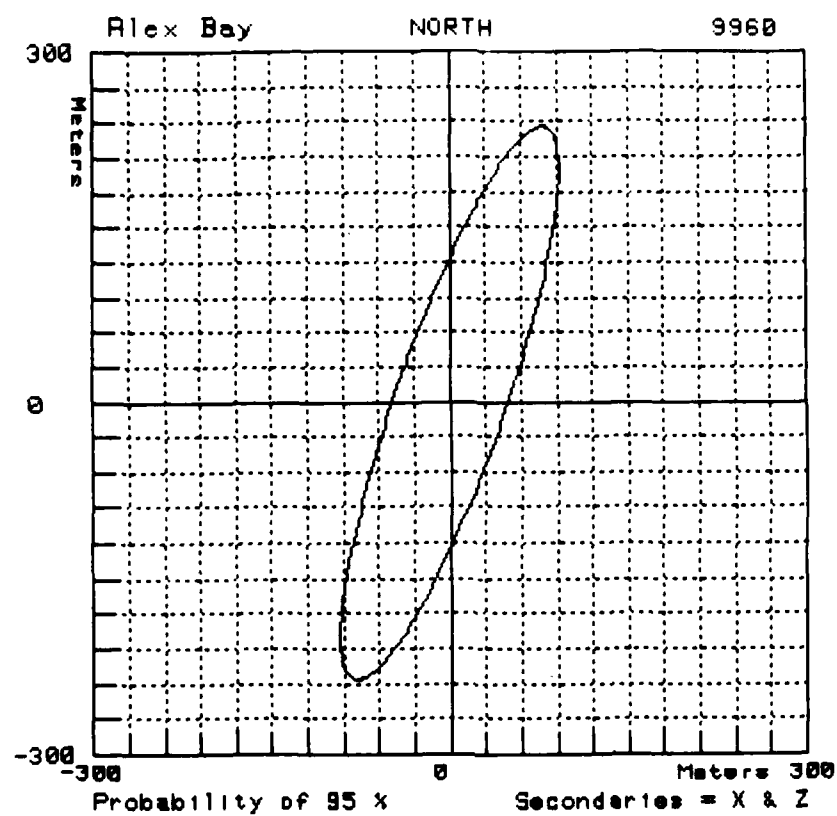
Positioning System
From Nautical Chart

W-LOP: 132 deg	Gradients: 526 ft/usec
X-LOP: 162 deg	Gradients: 773 ft/usec
Z-LOP: 224 deg	Gradients: 1304 ft/usec









HMS SITE INFORMATION

BASS HARBOR, MAINE

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 14 October 1982 - 30 March 1984

GRI: 9960 U.S. Northeast Chain

TDW: 12402.212
TDX: 25795.942

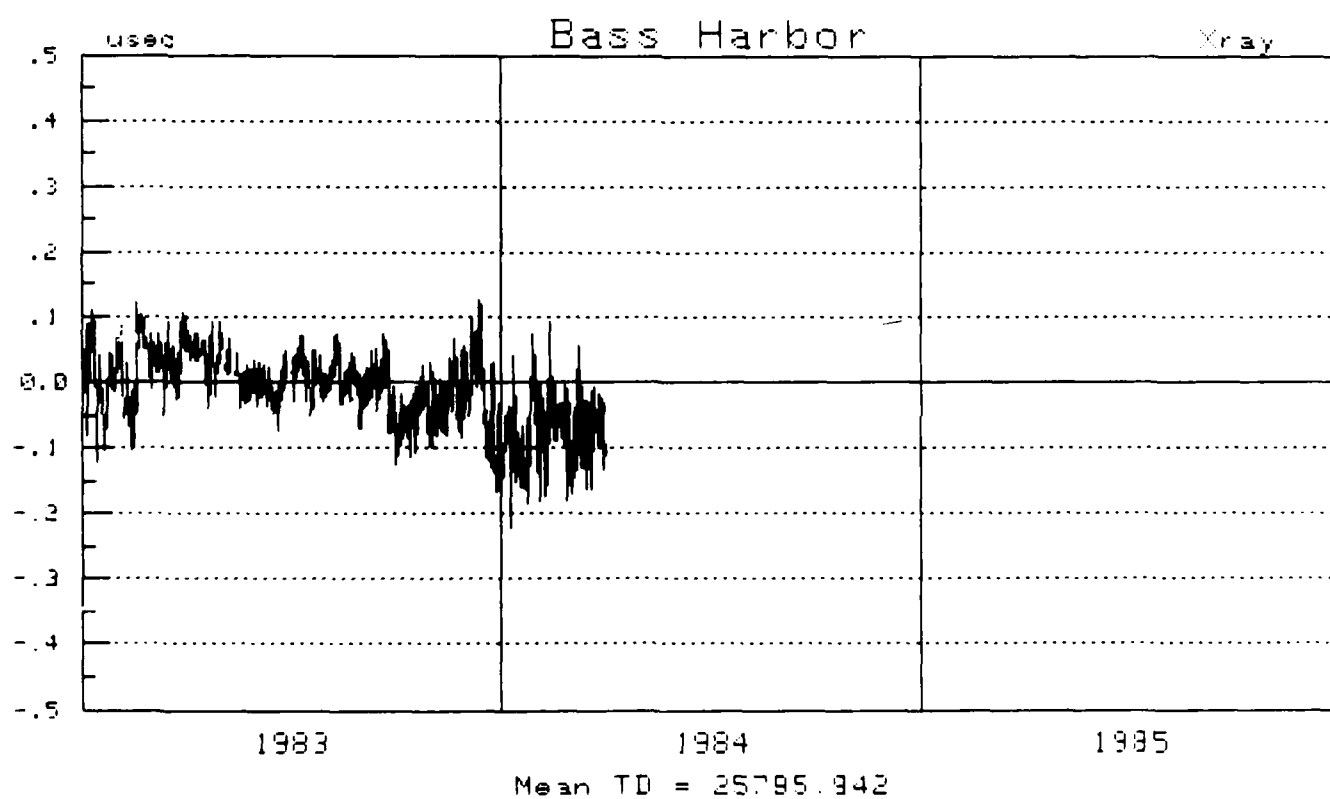
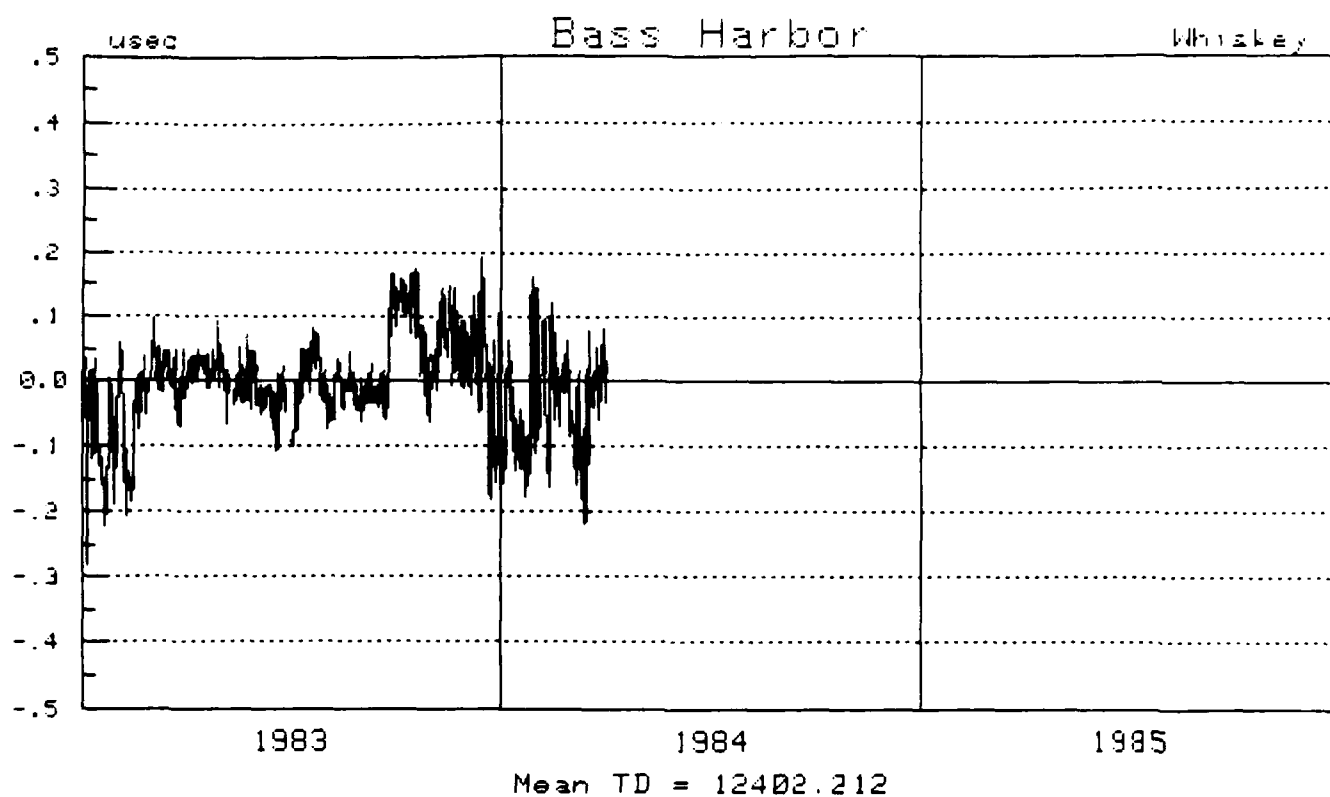
Receiving Antenna Location:

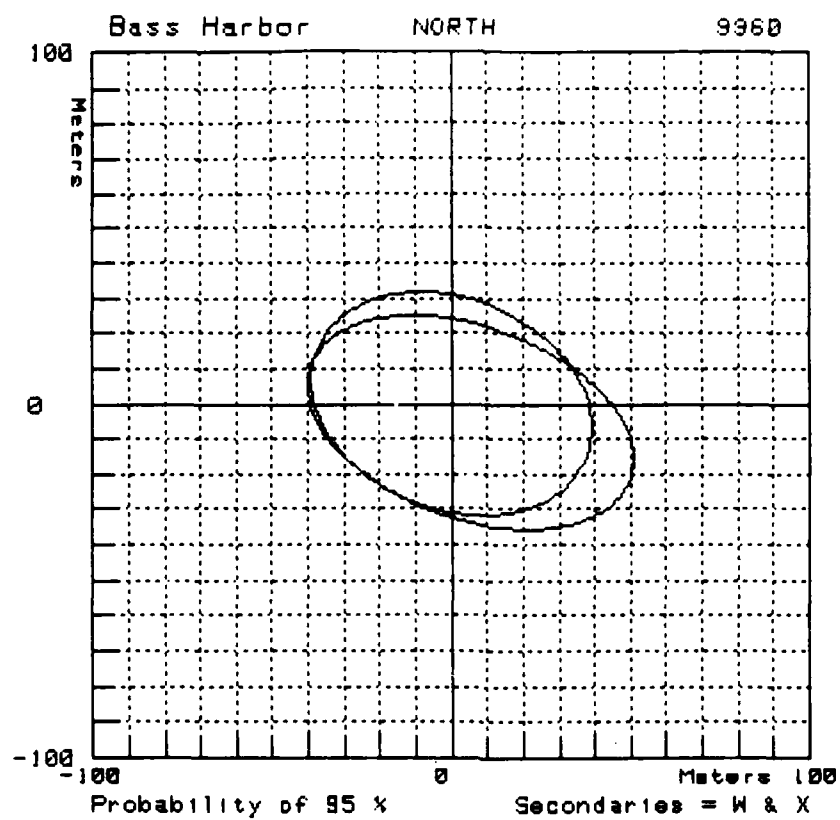
WGS 72
LAT : 44 13 20.56N
LON : 68 20 13.61W

NAD 27
LAT : 44 13 20.70N
LON : 68 20 15.30W

Positioning System
GPS

W-LOP: 312.7 deg Gradients: 612 ft/usec
X-LOP: 230.9 deg Gradients: 1038 ft/usec





HMS SITE INFORMATION

BEAUHARNOIS, QUEBEC, CANADA

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 14 September 1982 - 03 October 1983

GRI: 9960 U.S. Northeast Chain

TDW: 14209.177
TDX: 27579.426

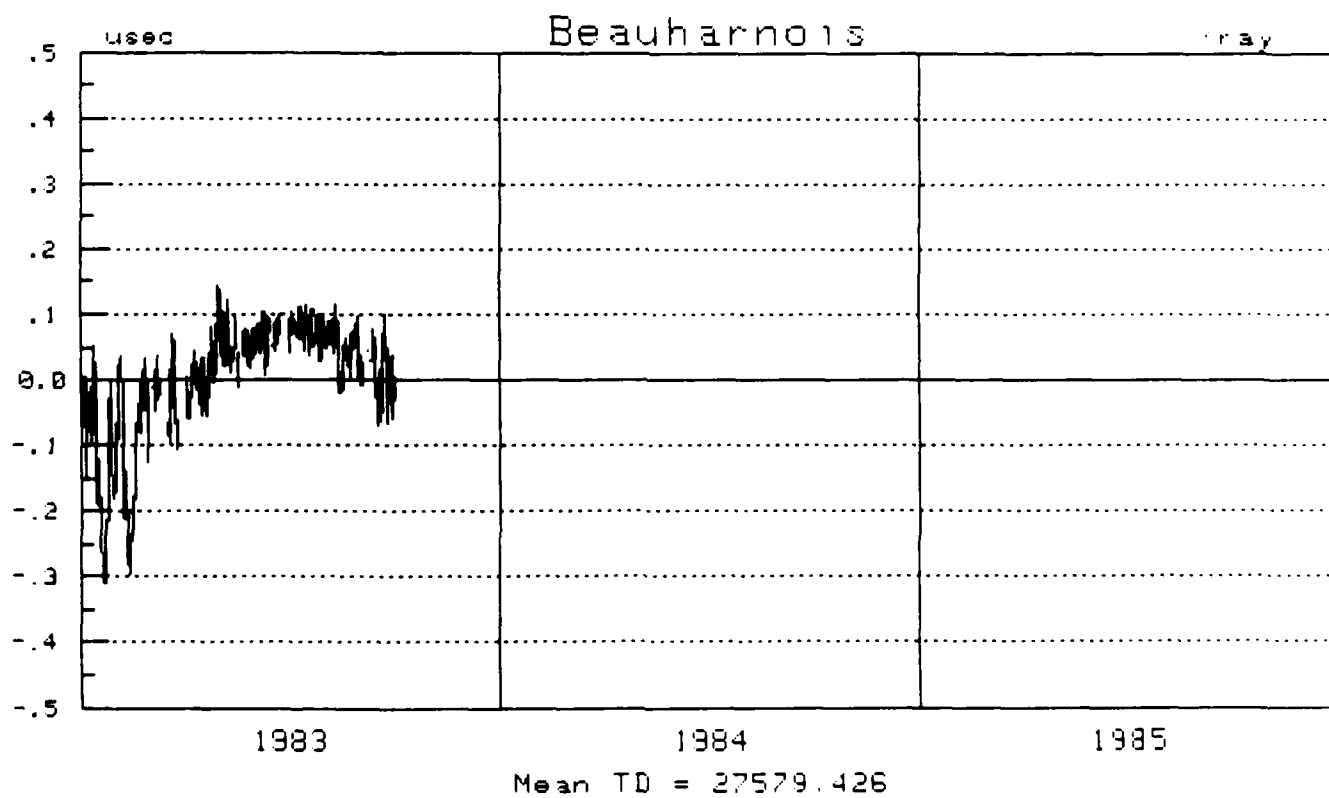
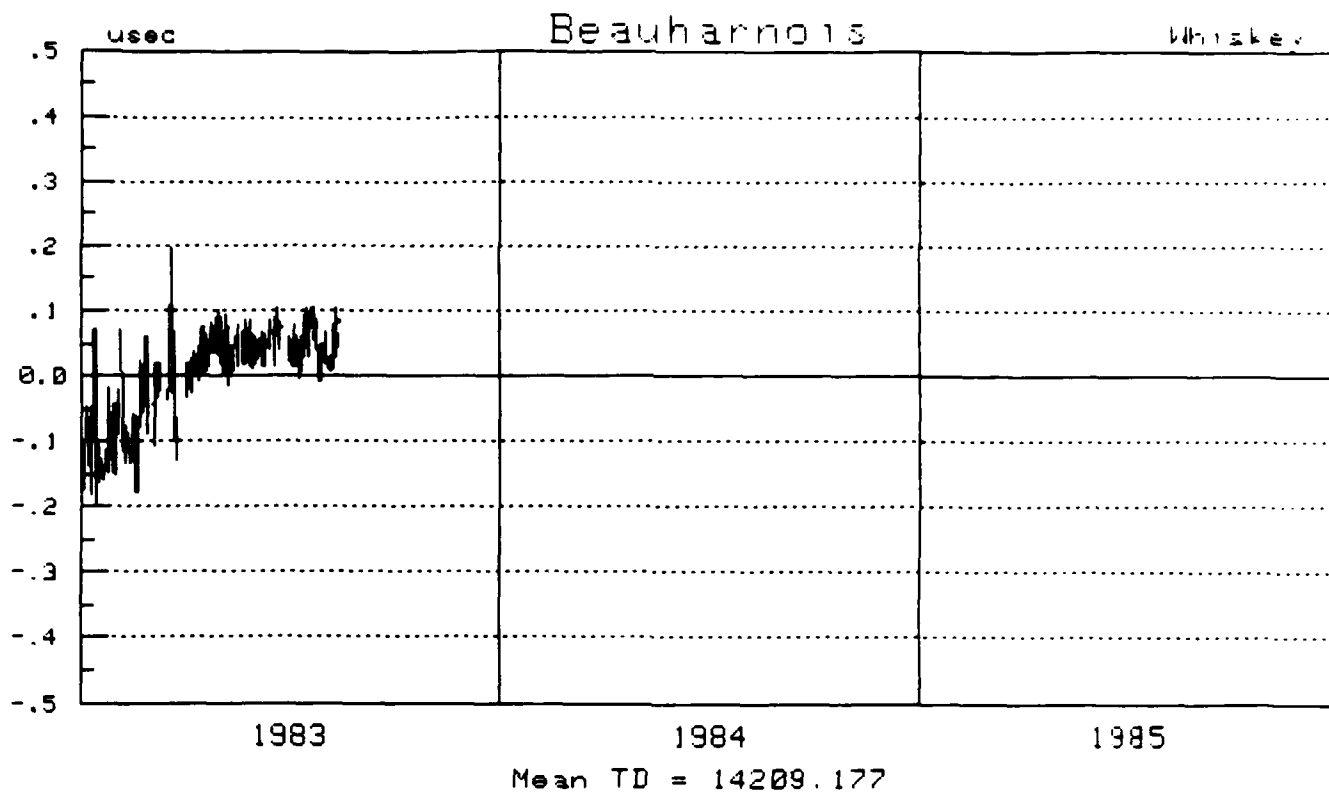
Receiving Antenna Location:

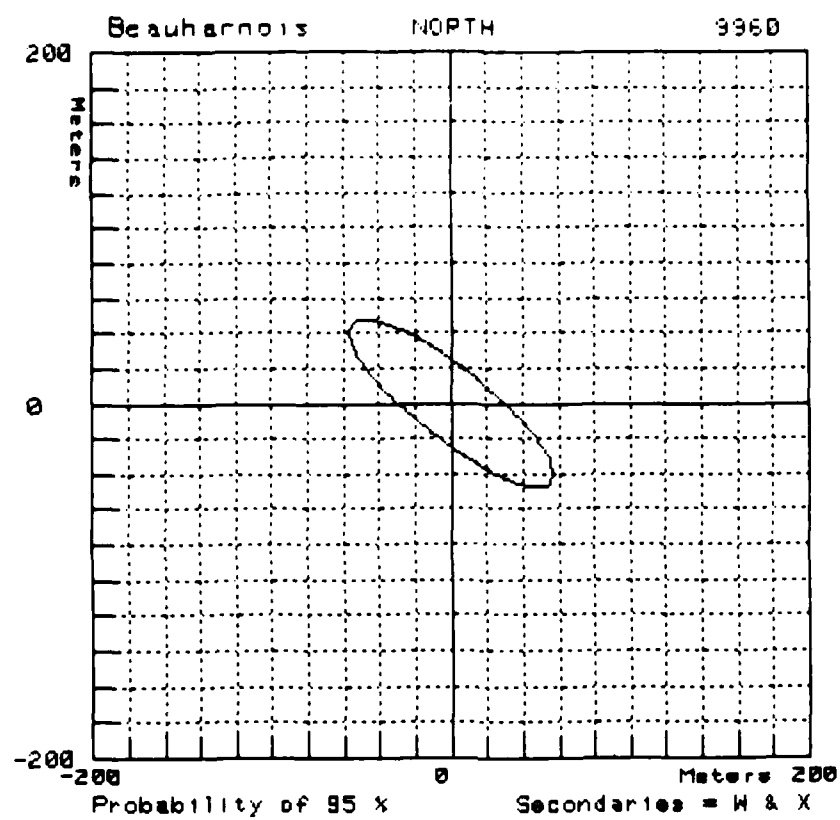
WGS 72
LAT : 45 18 18.11N
LON : 73 55 34.78W

NAD 27
LAT : 45 18 18.20N
LON : 73 55 35 80W

Positioning System
From Nautical Chart

W-LOP: 144 deg Gradients: 507 ft/usec
X-LOP: 181.5 deg Gradients: 792 ft/usec





HMS SITE INFORMATION

BRISTOL, RHODE ISLAND

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 09 July 1982 - 28 February 1985

GRI: 9960 U.S. Northeast Chain

TDX: 25782.543
TDY: 44065.106

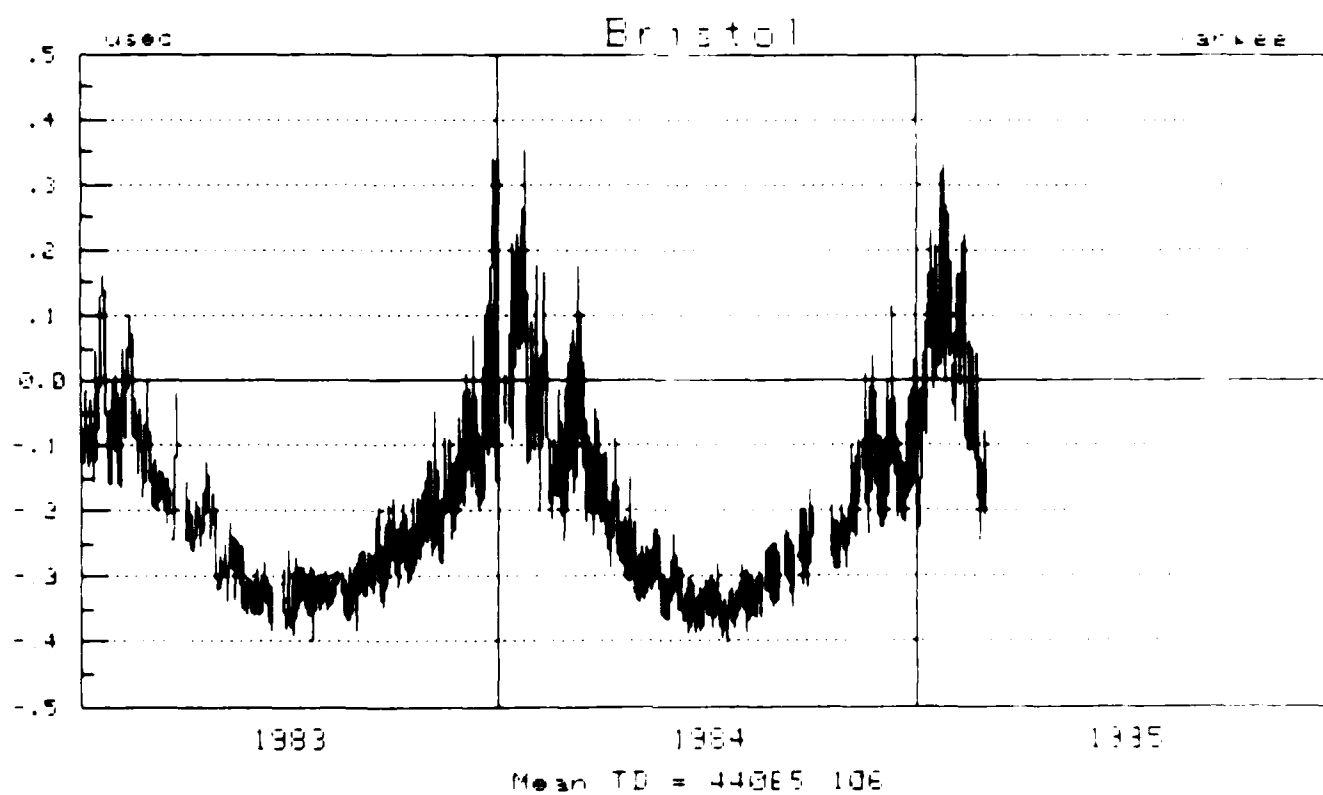
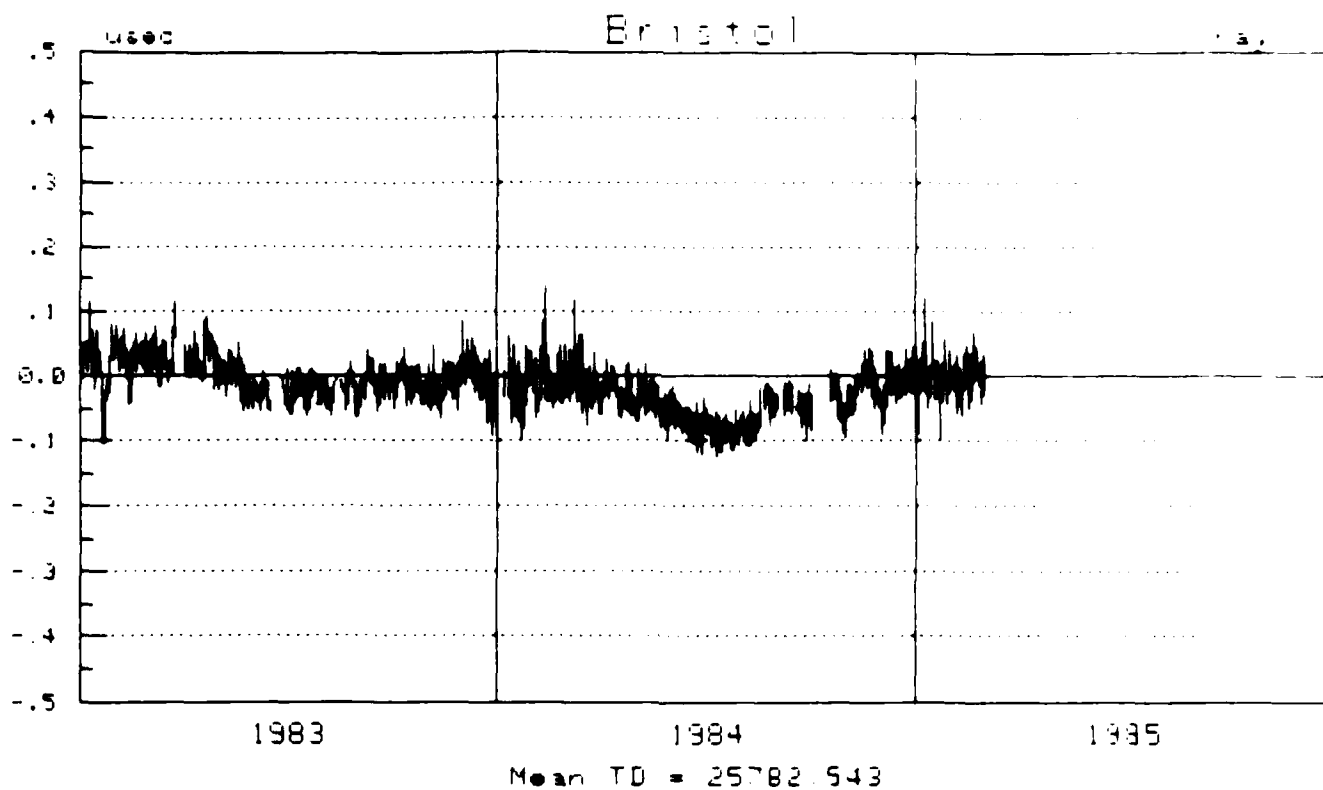
Receiving Antenna Location:

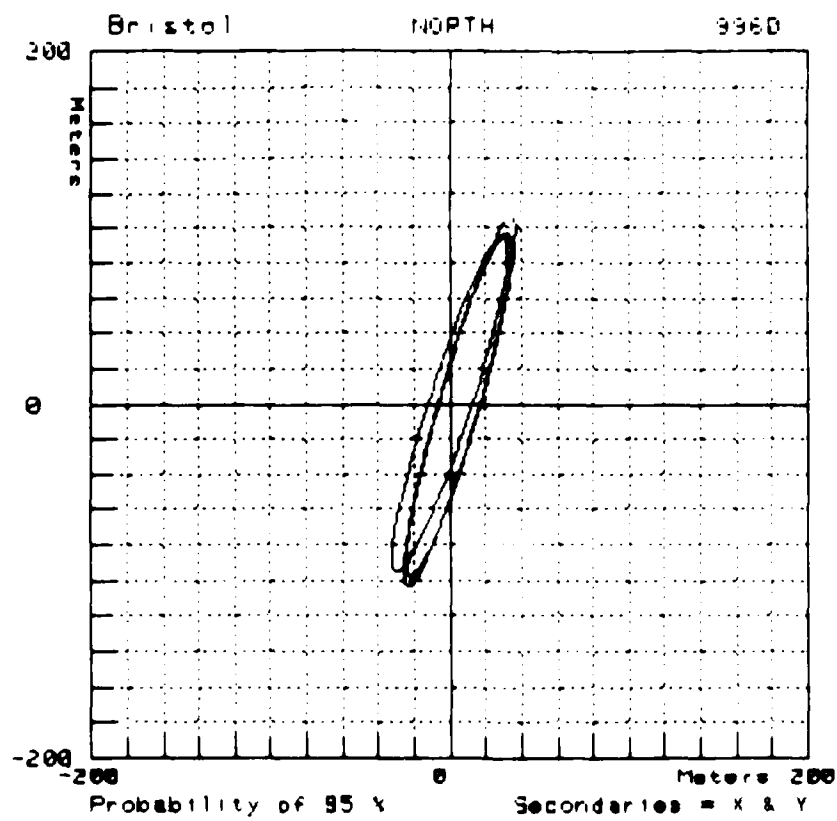
WGS 72
LAT : 41 39 58.86N
LON : 71 16 36.54W

NAD 27
LAT : 41 39 58.91N
LON : 71 16 37.82W

Positioning System
GPS

X-LOP: 199.3 deg Gradients: 492 ft/usec
Y-LOP: 251.4 deg Gradients: 864 ft/usec





HMS SITE INFORMATION

BROSSARD, QUEBEC, CANADA

Monitor: Type-D
Monitor Equipment: HP-9915 and LC-404
Data Collection: 12 September 1982 - 03 October 1983

GRI: 9960 U.S. Northeast Chain

TDW: 13973.931
TDX: 27442.482

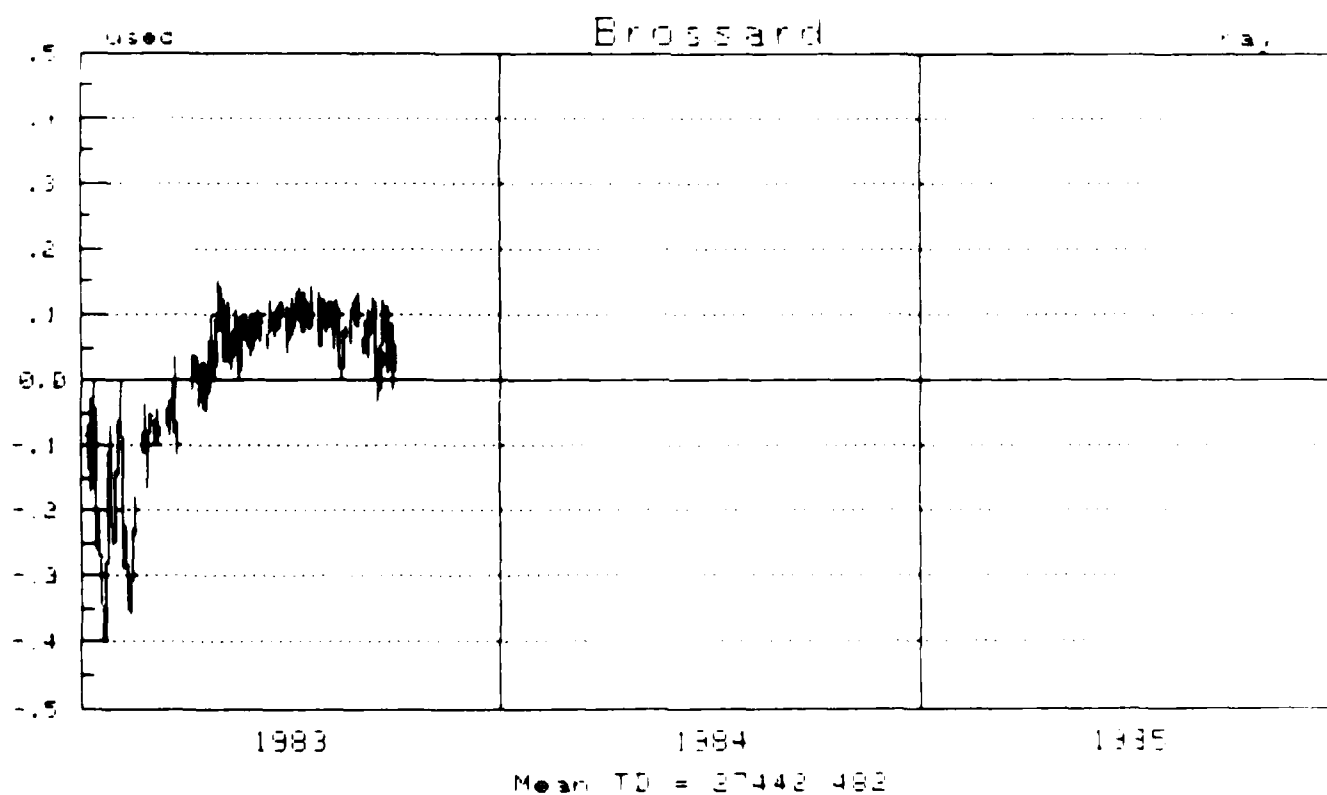
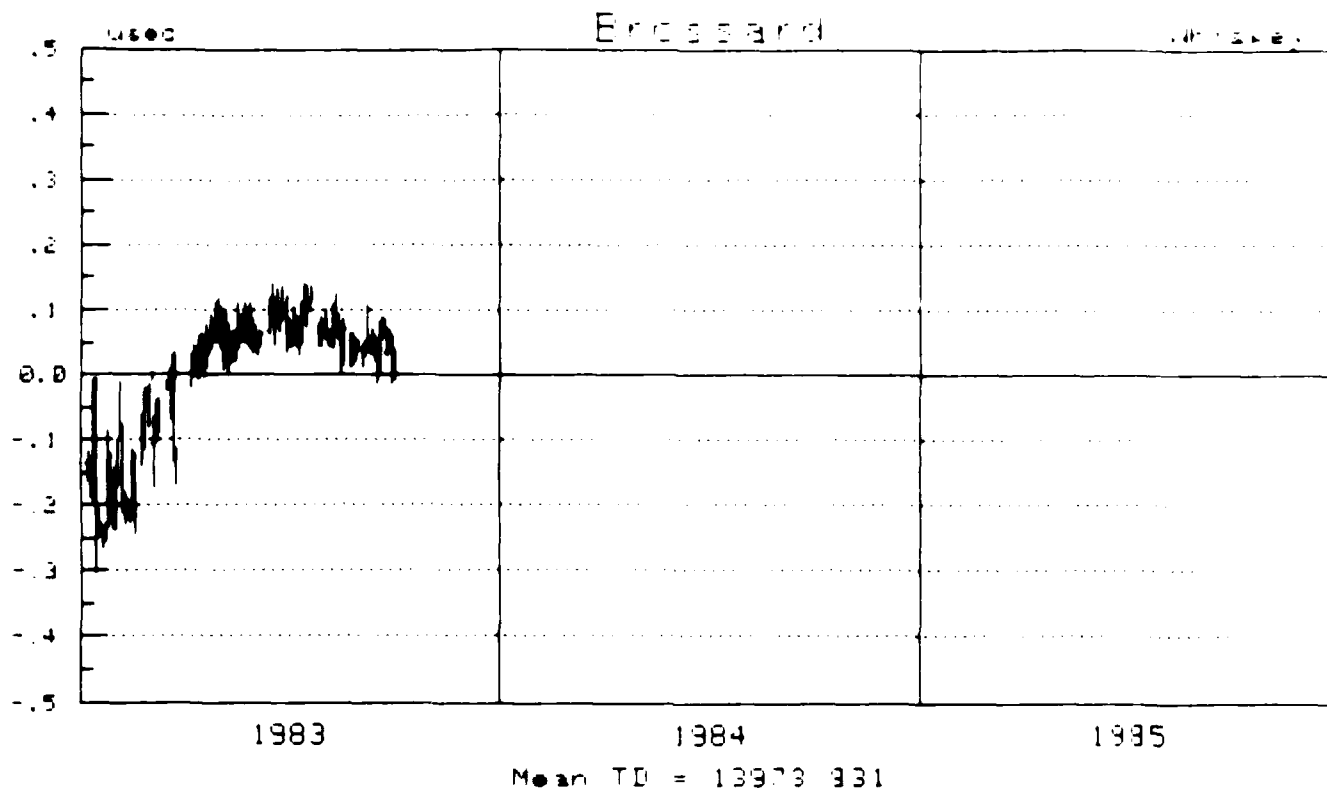
Receiving Antenna Location:

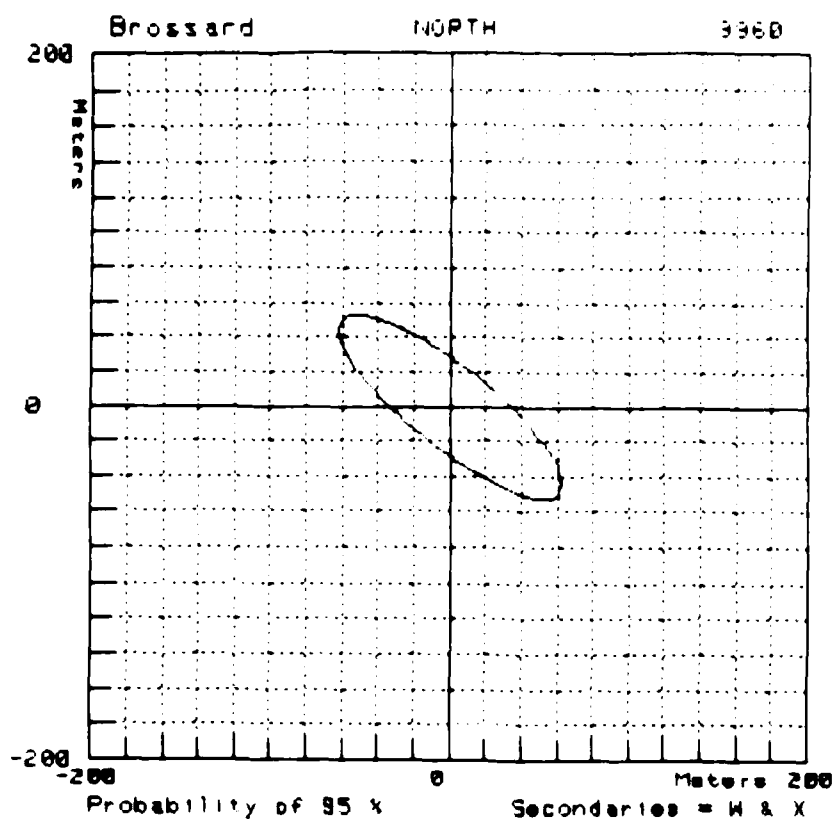
WGS 72
LAT : 45 26 4.9N
LON : 73 29 33.9W

NAD 27
LAT : 45 26 05N
LON : 73 29 35W

Positioning System
From Nautical Chart

W-LOP: 145.5 deg Gradients: 504 ft/usec
X-LOP: 184.9 deg Gradients: 804 ft/usec





HMS SITE INFORMATION

BUFFALO, NEW YORK

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 01 January 1984 - 12 August 1984

GRI: 9960 U.S. Northeast Chain

TDW: 16469.119
TDY: 44937.833
TDZ: 59245.190

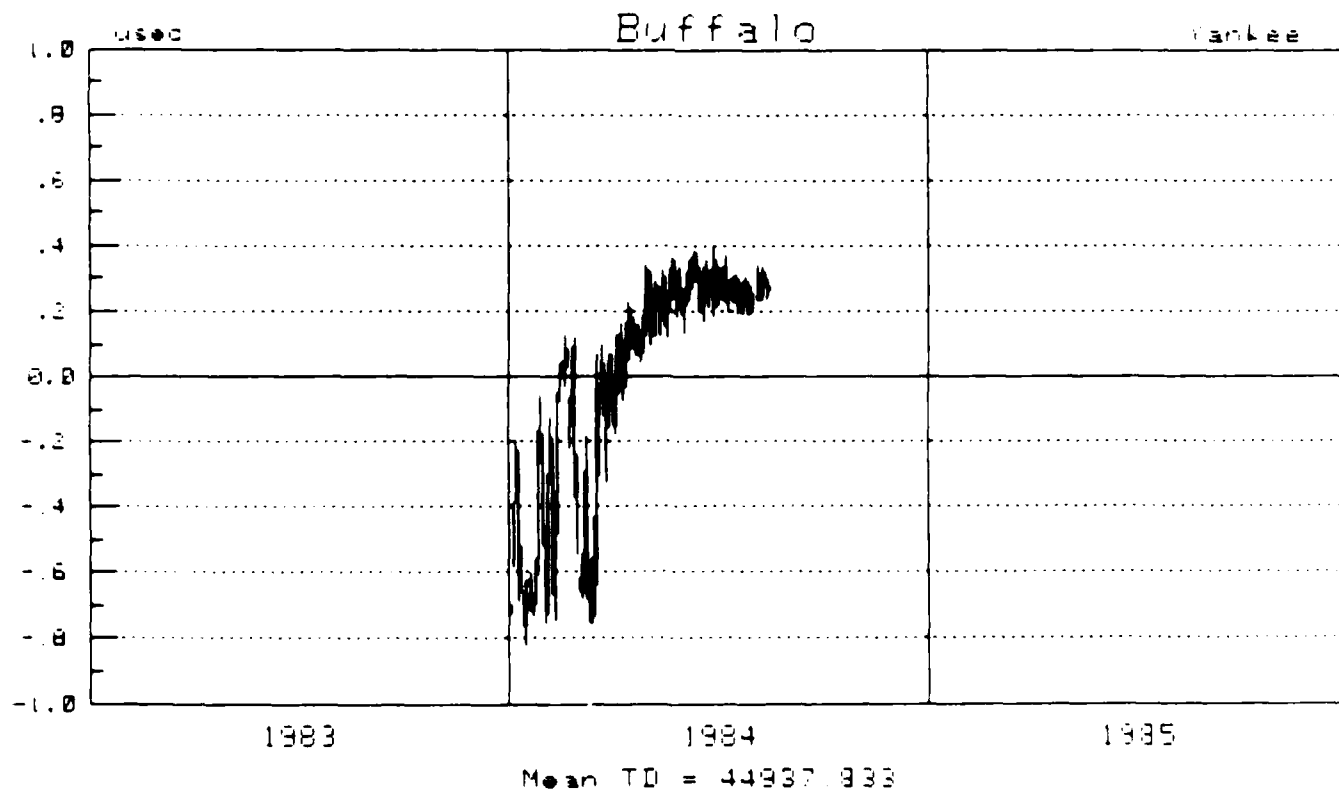
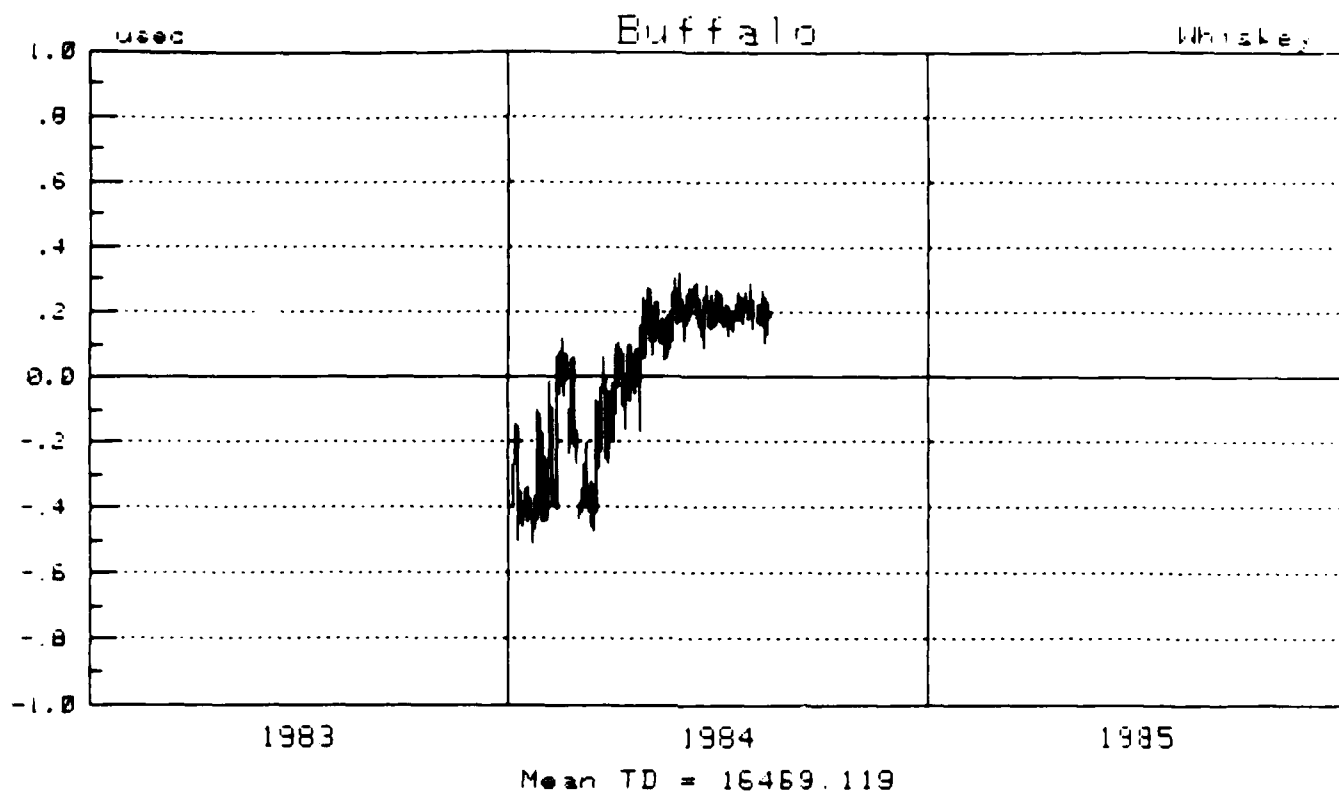
Receiving Antenna Location:

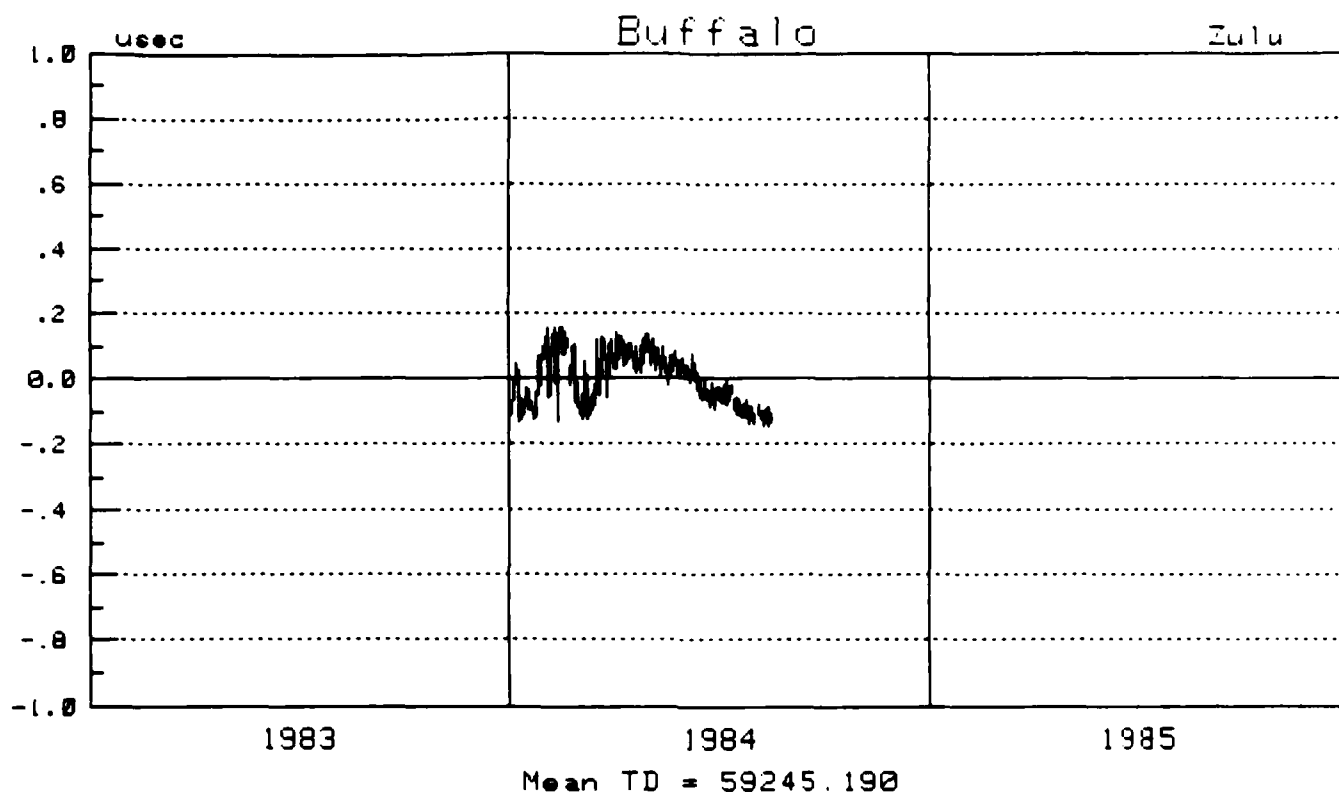
WGS 72
LAT : 42 52 39.82N
LON : 78 53 18.98W

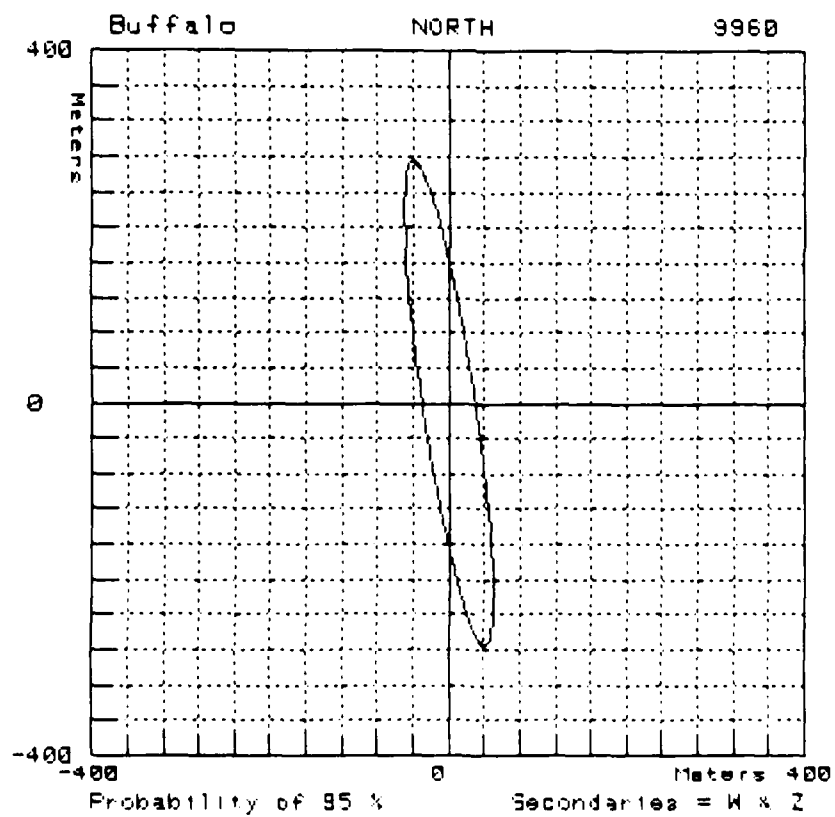
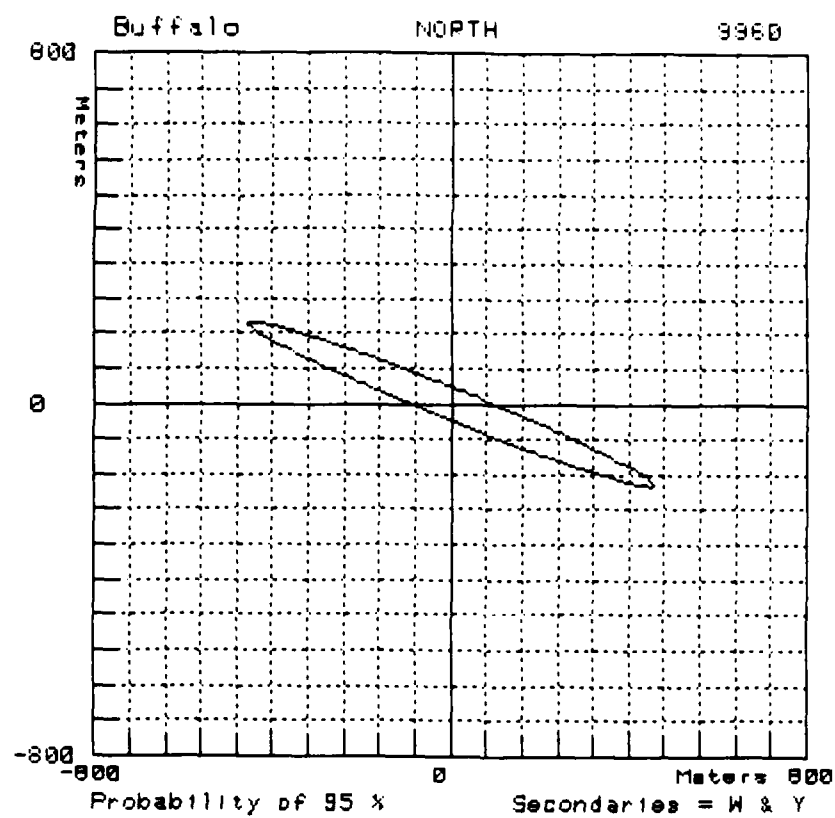
NAD 27
LAT : 42 52 39.84N
LON : 78 53 19.36W

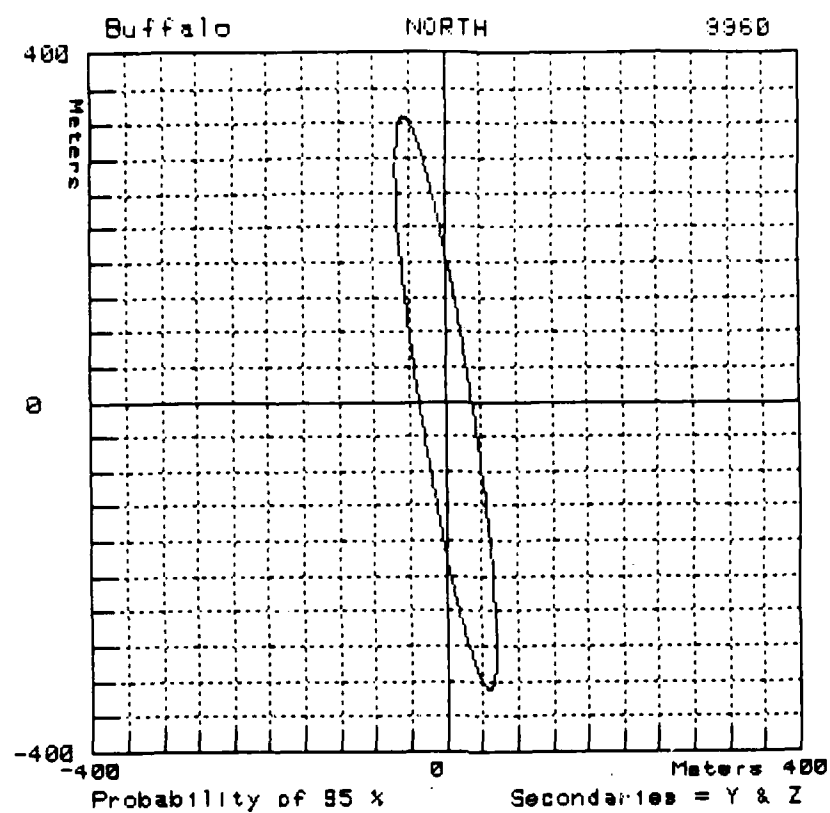
Positioning System
GPS

W-LOP: 77.5 deg	Gradients: 1587 ft/usec
Y-LOP: 135.1 deg	Gradients: 771 ft/usec
Z-LOP: 171.7 deg	Gradients: 506 ft/usec









HMS SITE INFORMATION

BURLINGTON, VERMONT

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 21 August 1984 - October 1985

GRI: 9960 U.S. Northeast Chain

TDW: 14221.546
TDX: 27253.516
TDY: 45128.301

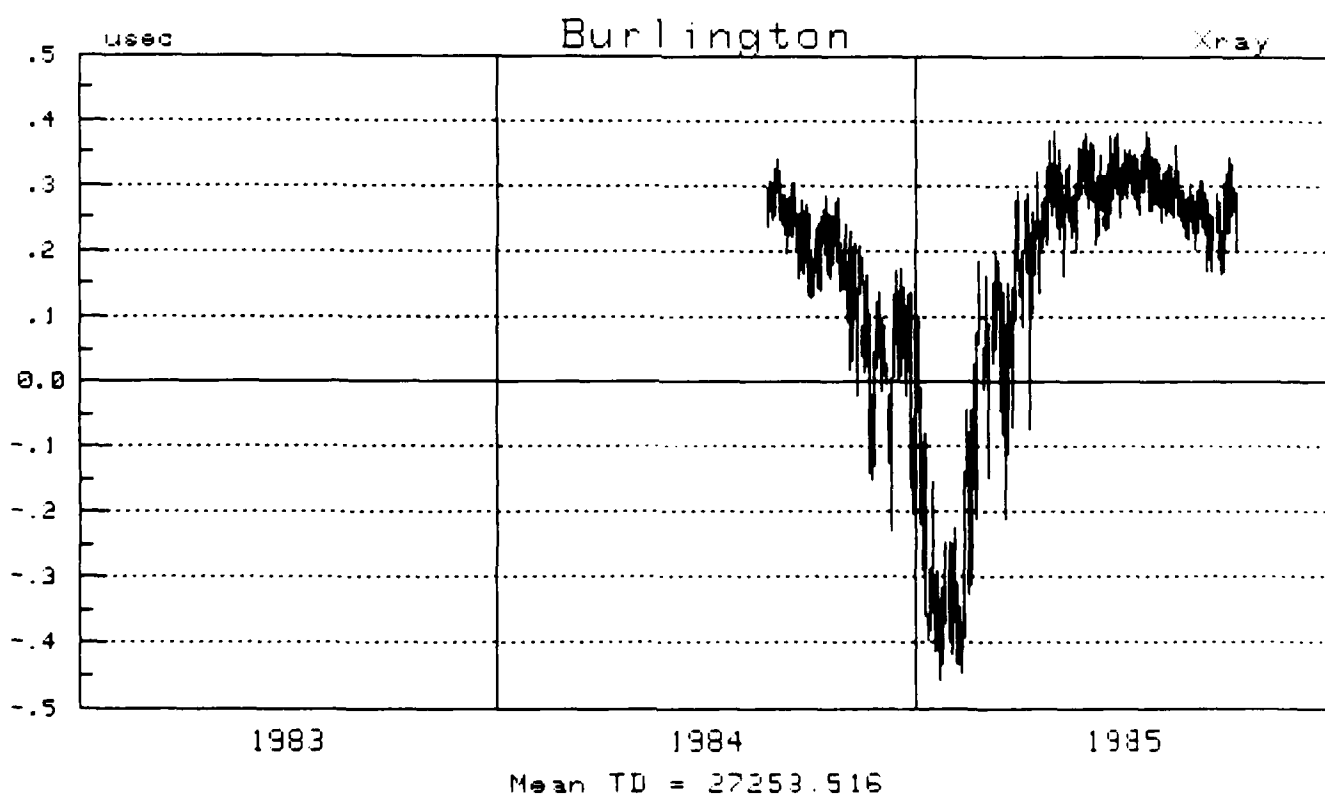
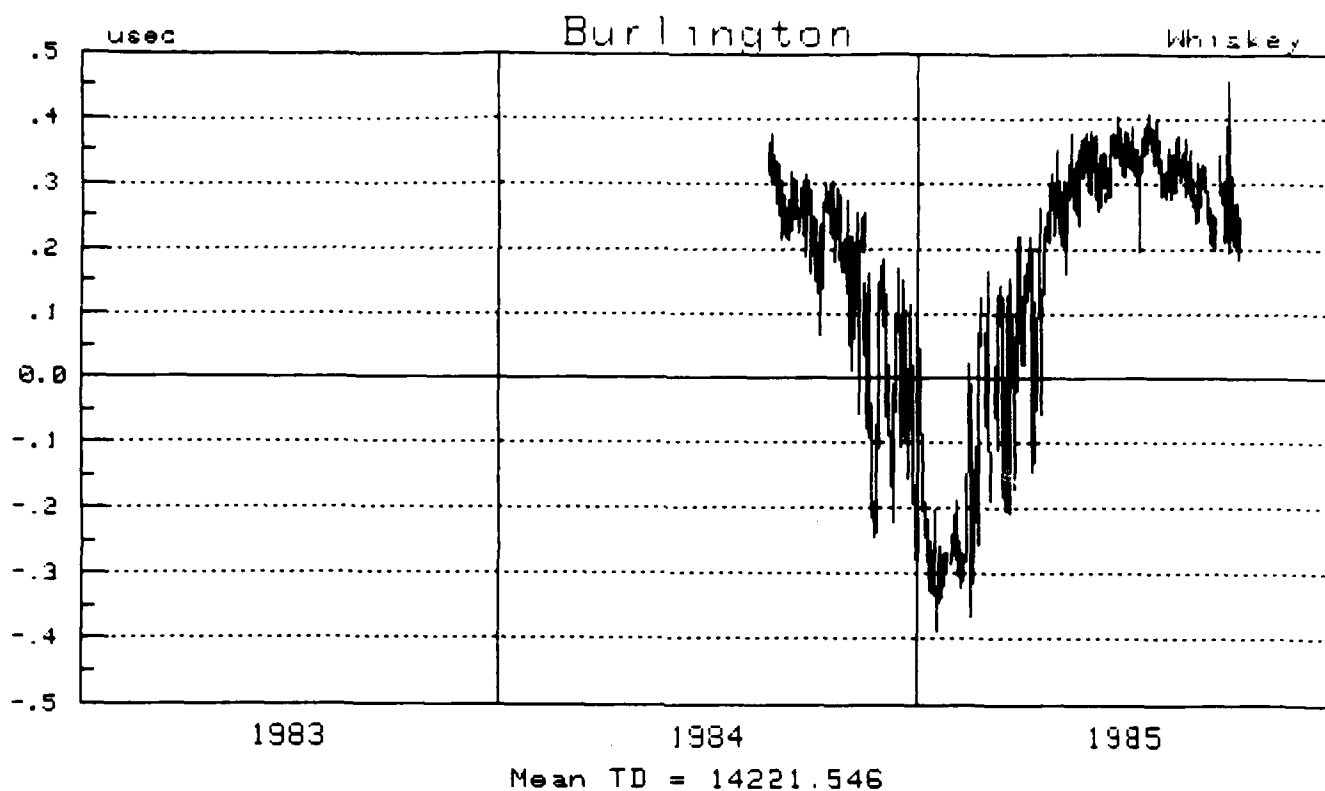
Receiving Antenna Location:

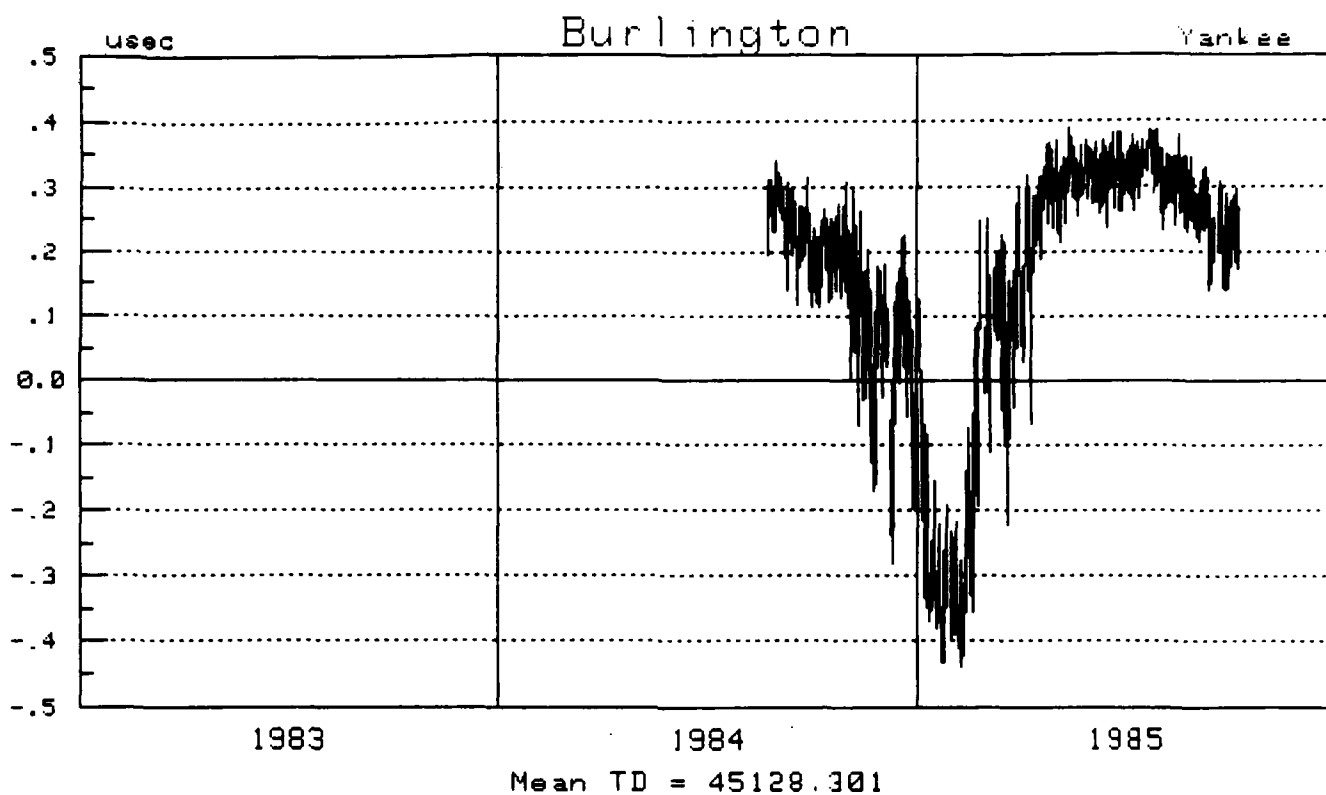
WGS 72
LAT : 44 27 54.96N
LON : 73 08 25.01W

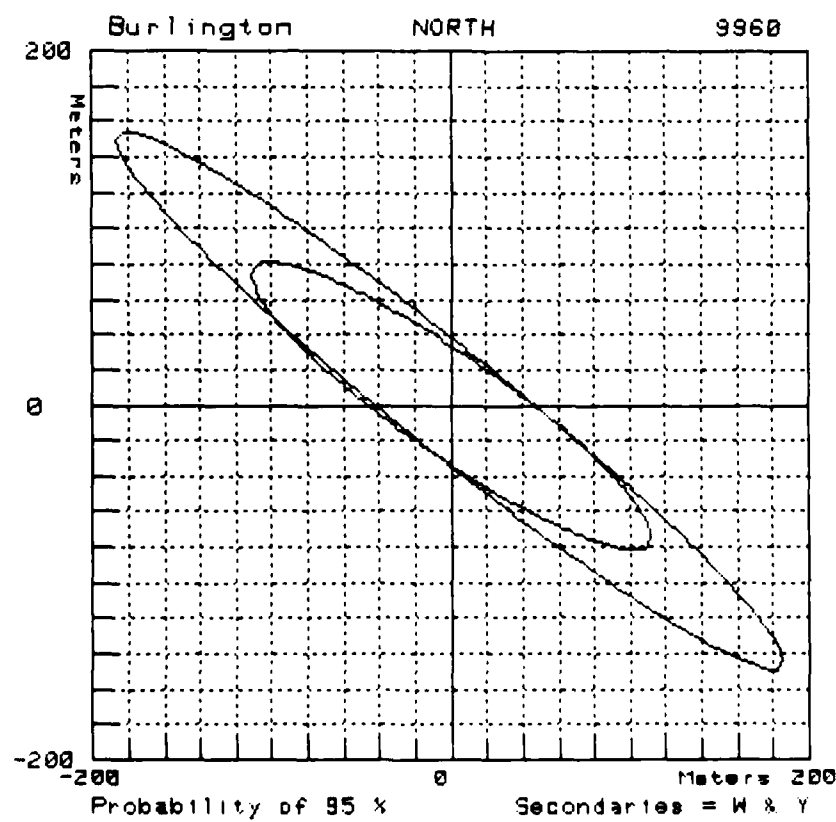
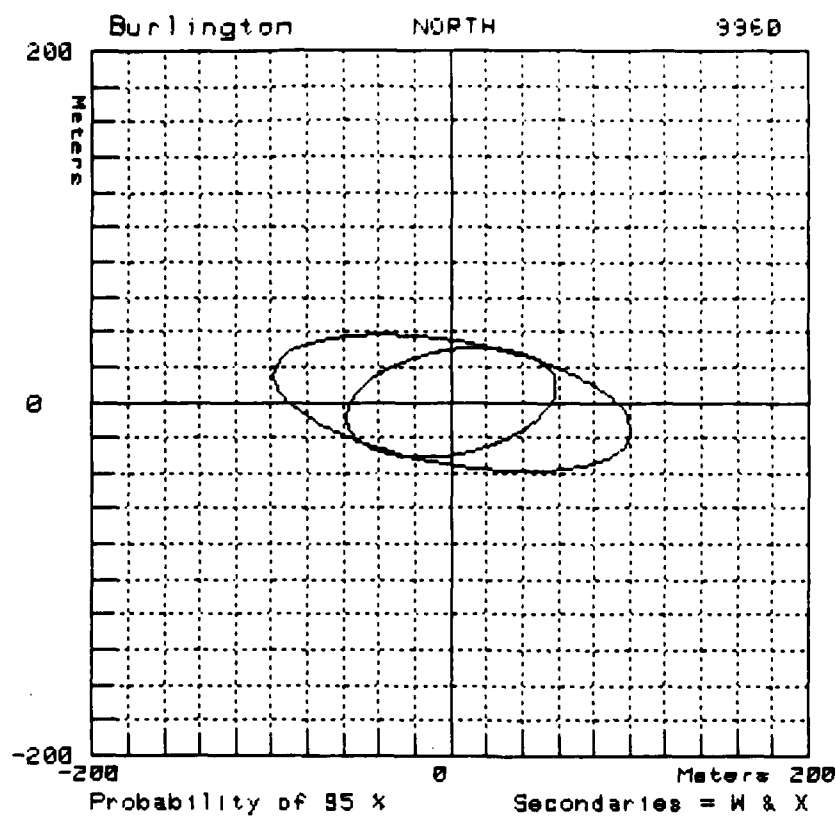
NAD 27
LAT : 44 27 55.05N
LON : 73 08 26.11W

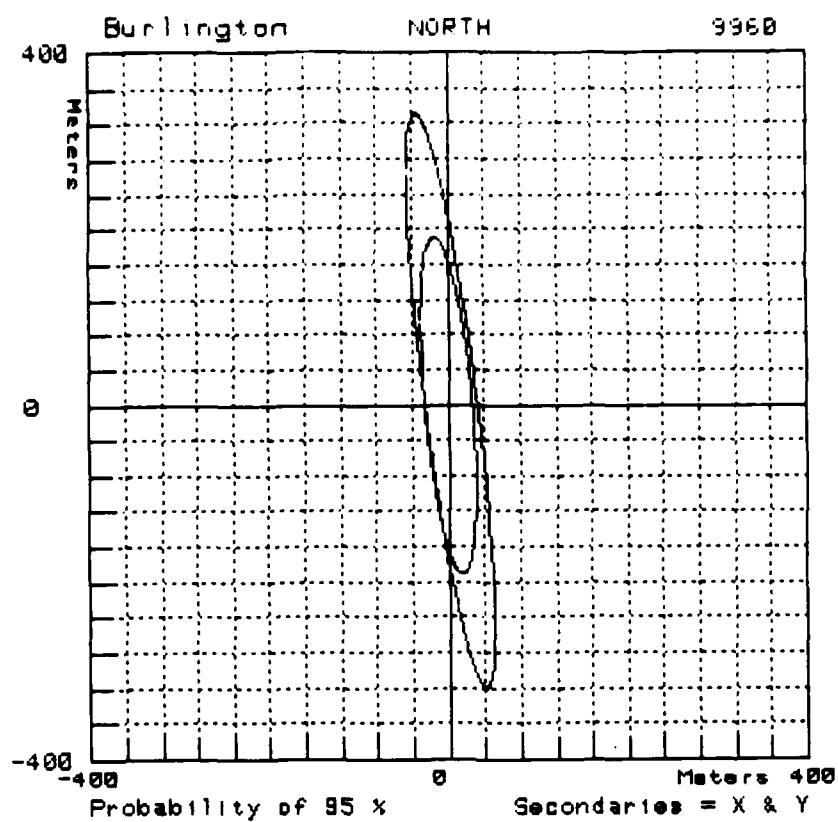
Positioning System
GPS

W-LOP: 146.8 deg	Gradients: 492 ft/usec
X-LOP: 190.4 deg	Gradients: 667 ft/usec
Y-LOP: 219.5 deg	Gradients: 1557 ft/usec









HMS SITE INFORMATION

CAPE ELIZABETH, MAINE

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 01 September 1980 - Present

GRI: 9960 U.S. Northeast Chain

TDW: 13311.479 A1 Control
TDX: 25999.390 A2
TDY: 44561.713 A2

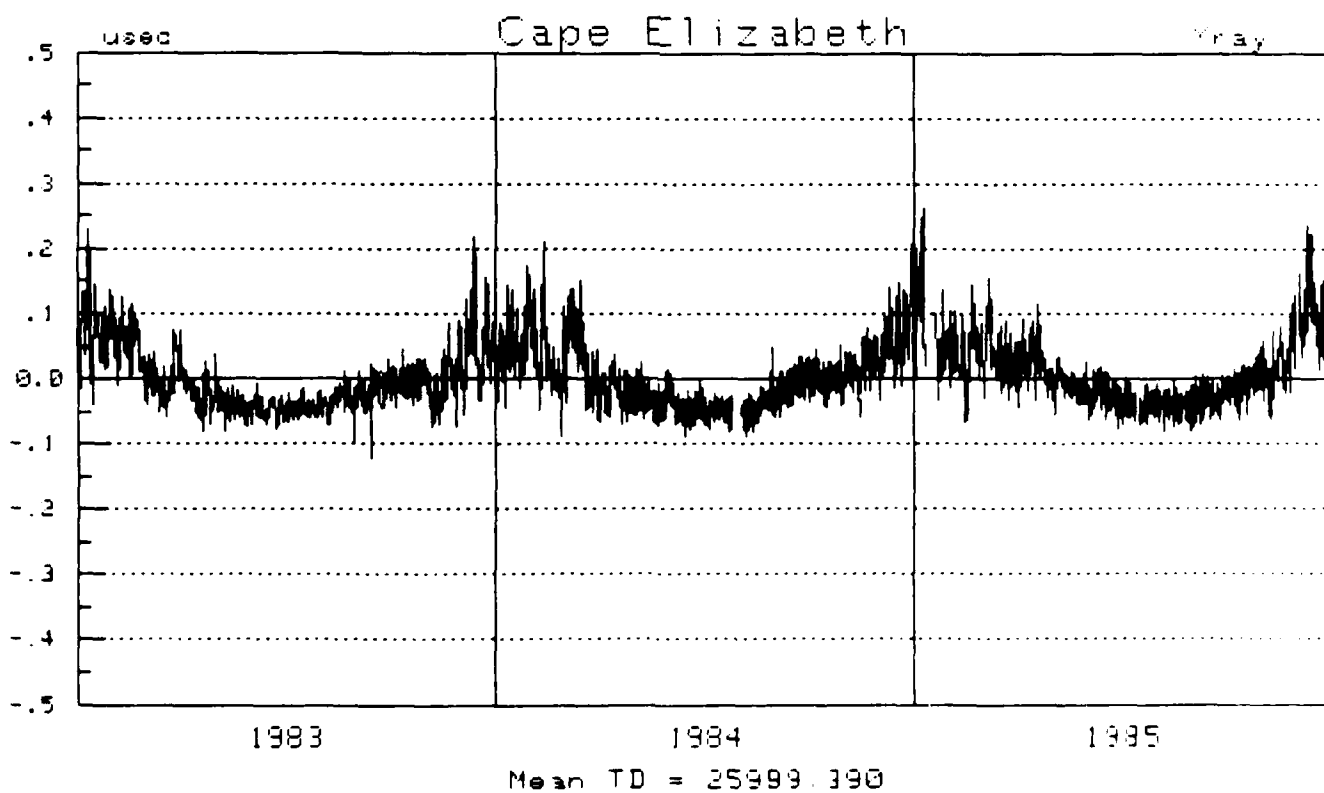
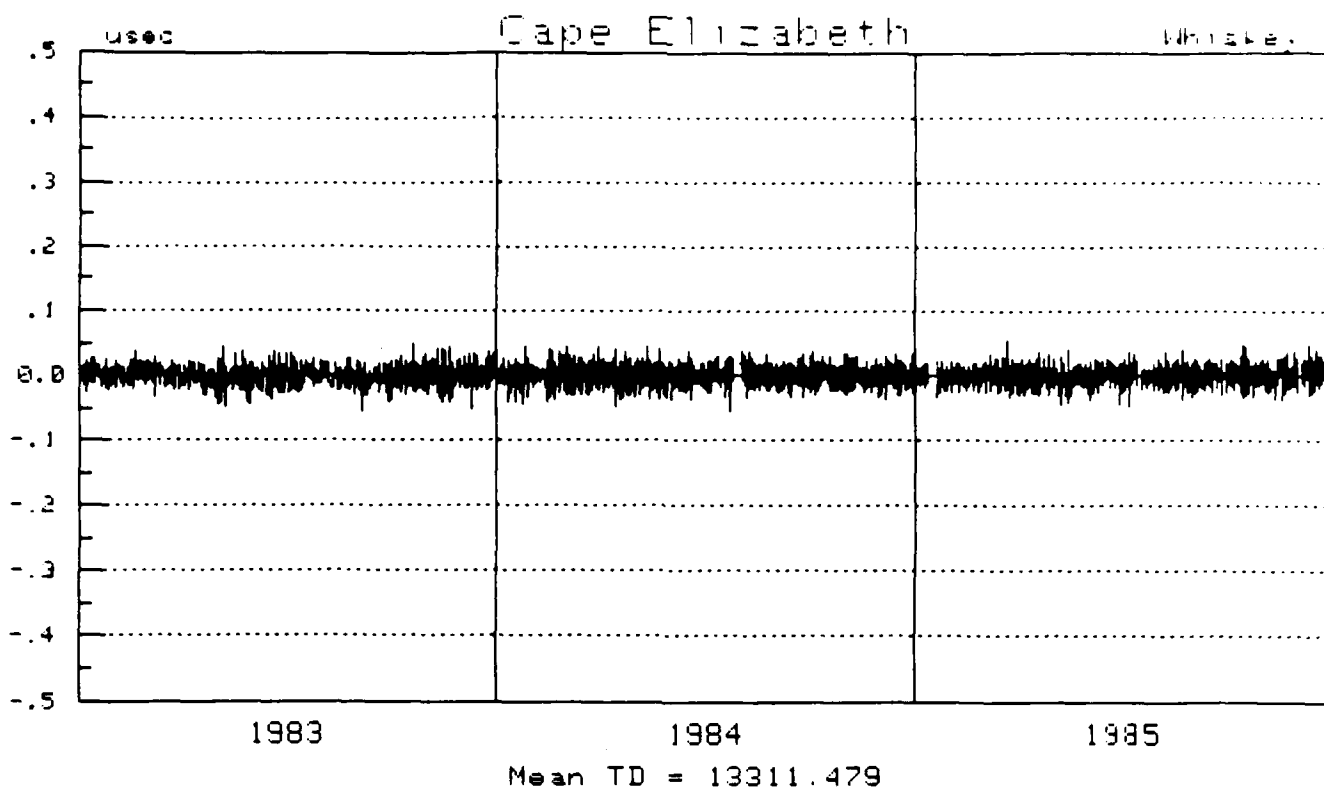
Receiving Antenna Location:

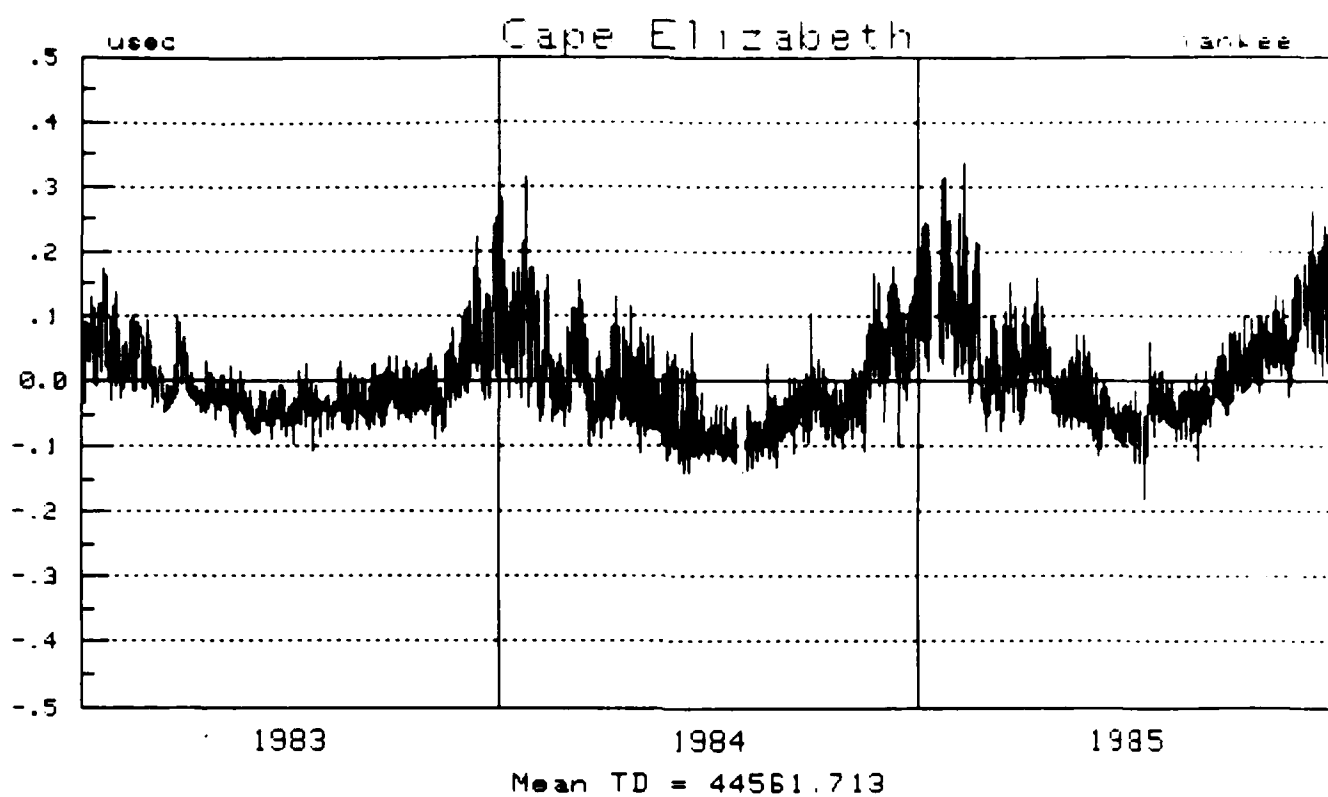
WGS 72
LAT : 43 33 54.82N
LON : 70 11 58.54W

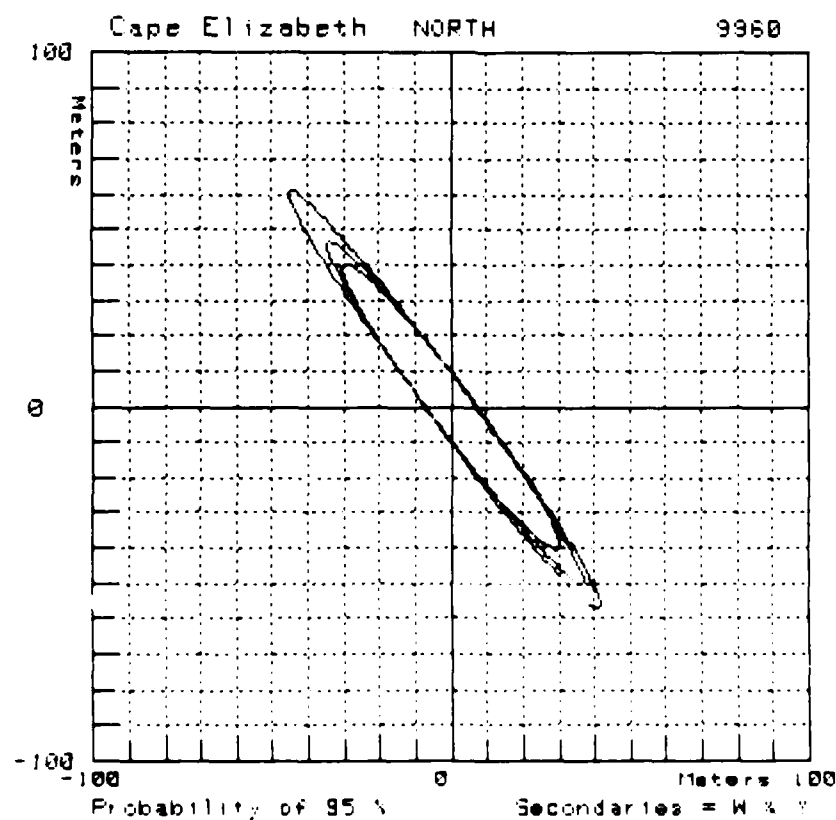
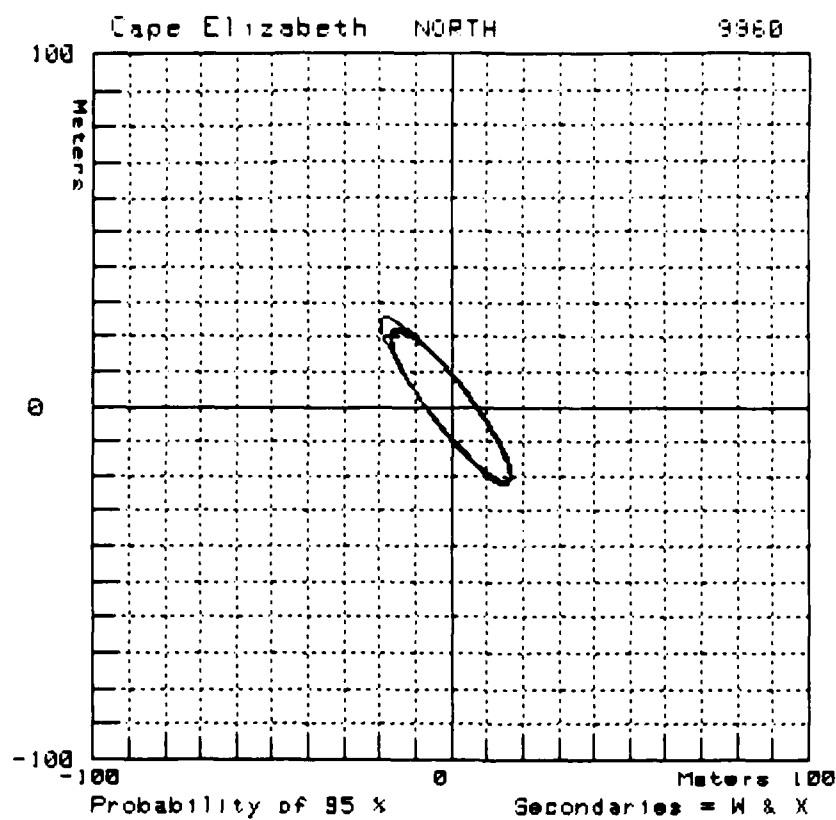
NAD 27
LAT : 43 33 54.93N
LON : 70 11 59.99W

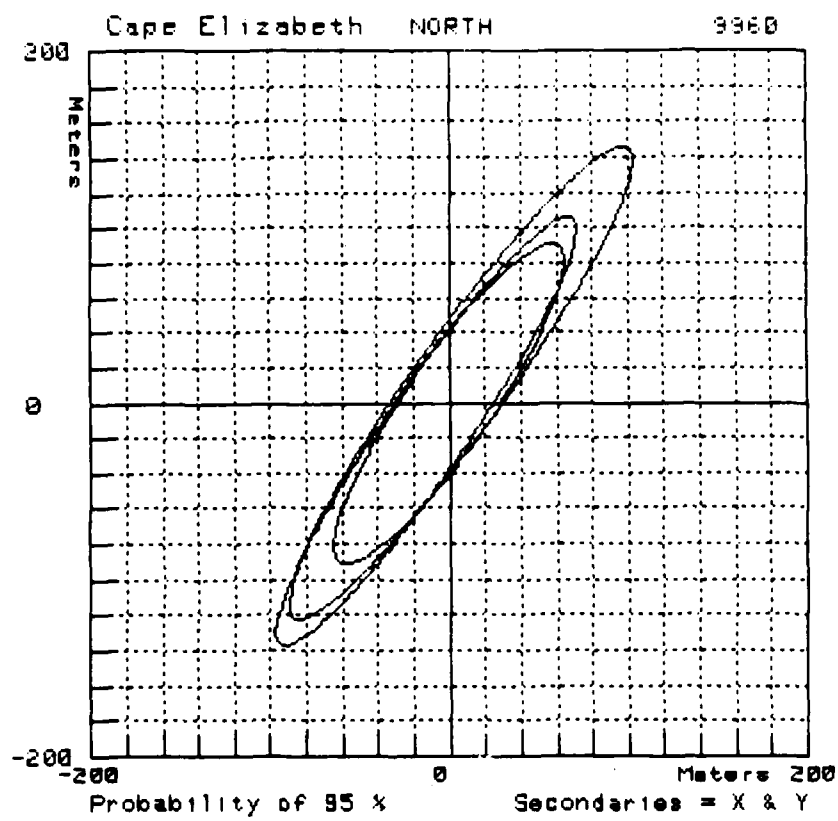
Positioning System
From G-NRN

W-LOP: 143.9 deg	Gradients: 559 ft/usec
X-LOP: 219.1 deg	Gradients: 718 ft/usec
Y-LOP: 238.6 deg	Gradients: 1223 ft/usec









HMS SITE INFORMATION

CAPE VINCENT, NY

Monitor: Type-D
Monitor Equipment: HP-9915 and LC-404
Data Collection: 18 September 1982 - 16 September 1983

GRI: 9960 U.S. Northeast Chain

TDW: 15691.875
TDX: 28485.625

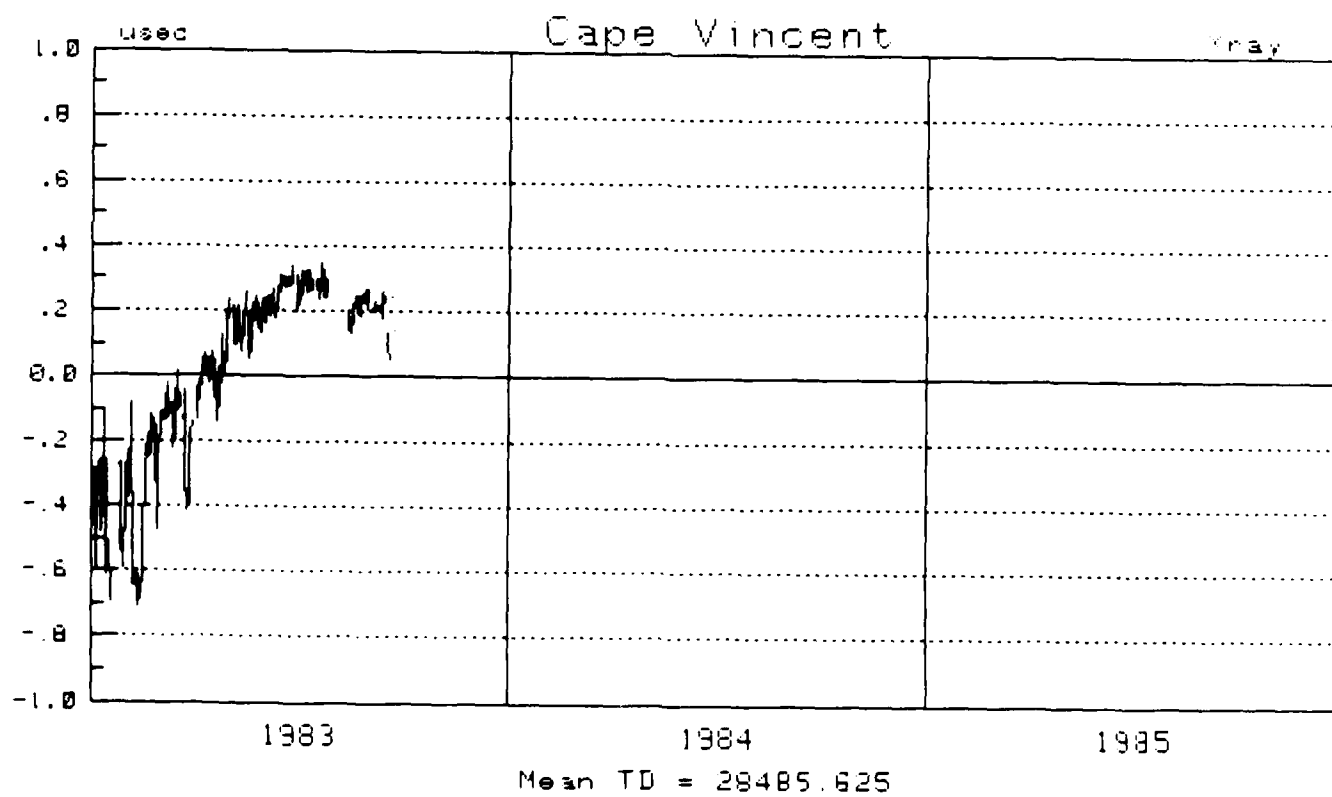
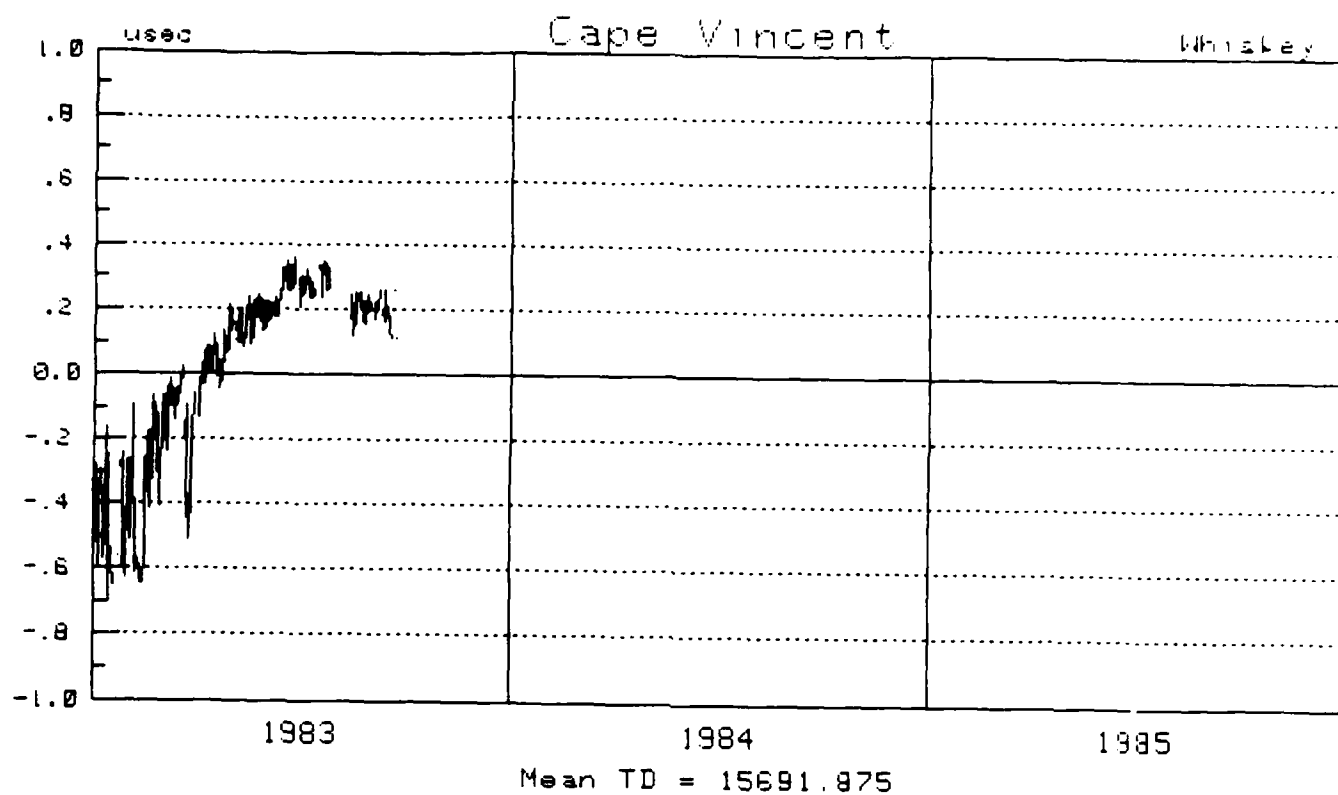
Receiving Antenna Location:

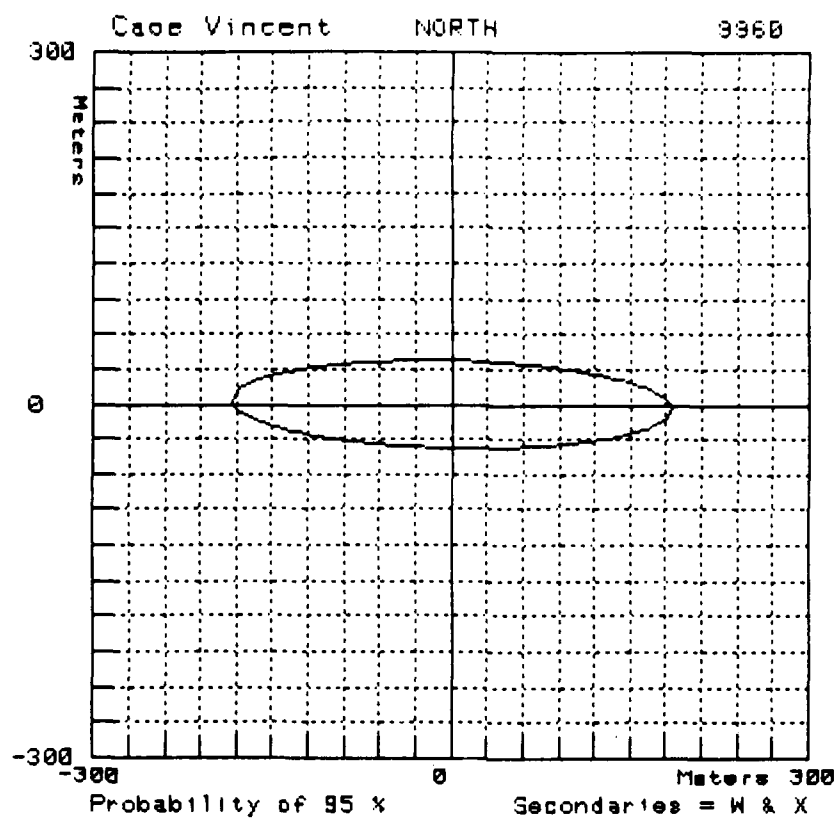
WGS 72
LAT : 44 06 2.53N
LON : 76 22 13.44W

NAD 27
LAT : 44 06 2.59N
LON : 76 22 14.14W

Positioning System
GPS

W-LOP: 128 deg Gradients: 540 ft/usec
X-LOP: 156 deg Gradients: 810 ft/usec





AD-A183 477

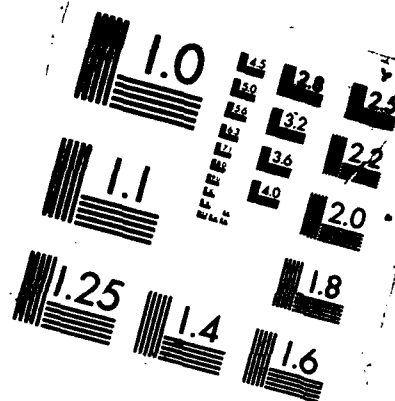
HARBOR MONITOR SYSTEM(U) COAST GUARD RESEARCH AND
DEVELOPMENT CENTER GROTON CT M M BLIZARD ET AL. DEC 86
CGR/DC-03/86 USCG-D-17-87

3/3

UNCLASSIFIED

F/G 17/7.2 NL

END
9-87
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

HMS SITE INFORMATION

DUNBAR FOREST, MICHIGAN

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 14 March 1983 - 24 May 1984
and 25 September 1985 - Present

GRI: 9960 U.S. Northeast Chain

TDZ: 57345.415 A2

Receiving Antenna Location:

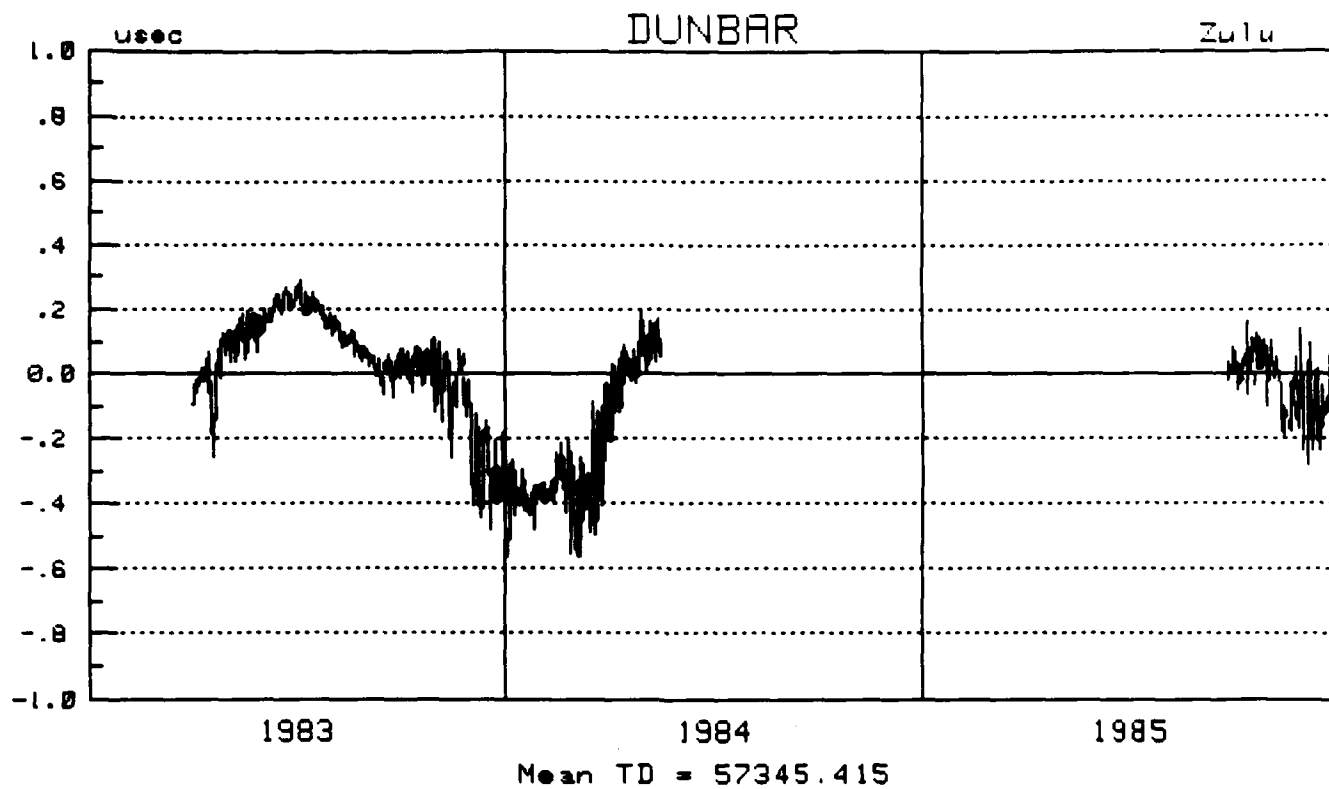
WGS 72
LAT : 46 19 14.37N
LON : 84 13 27.16W

NAD 27
LAT : 46 19 14.43N
LON : 84 13 26.88W

Positioning System
GPS

Z-LOP: 161.5 deg

Gradients: 779 ft/usec



HMS SITE INFORMATION

GLOUCESTER CITY, NEW JERSEY

Monitor: Type-C
Monitor Equipment: LC-404 and PCM-12
Data Collection: 07 October 1981 - 20 March 1984

GRI: 9960 U.S. Northeast Chain

TDX: 27361.327

TDY: 43390.028

TDZ: 59543.684

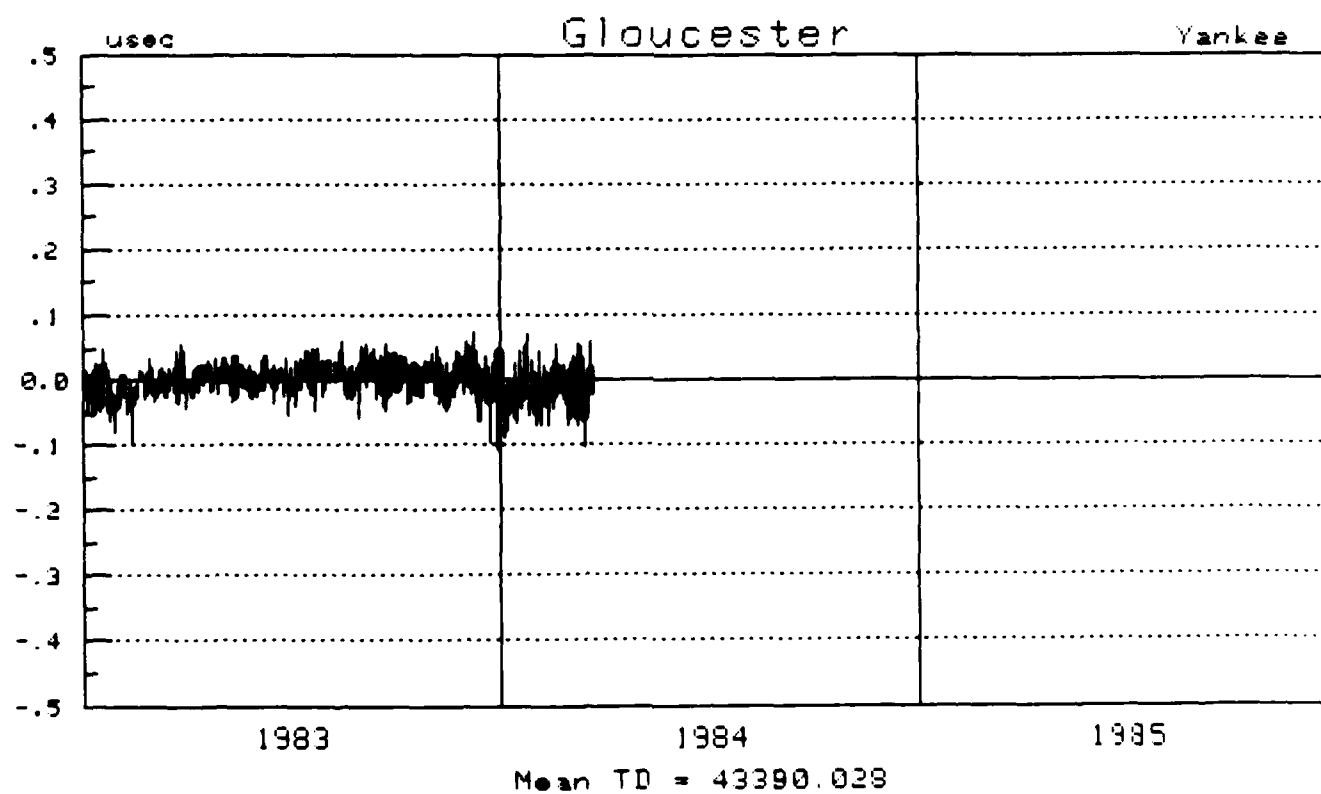
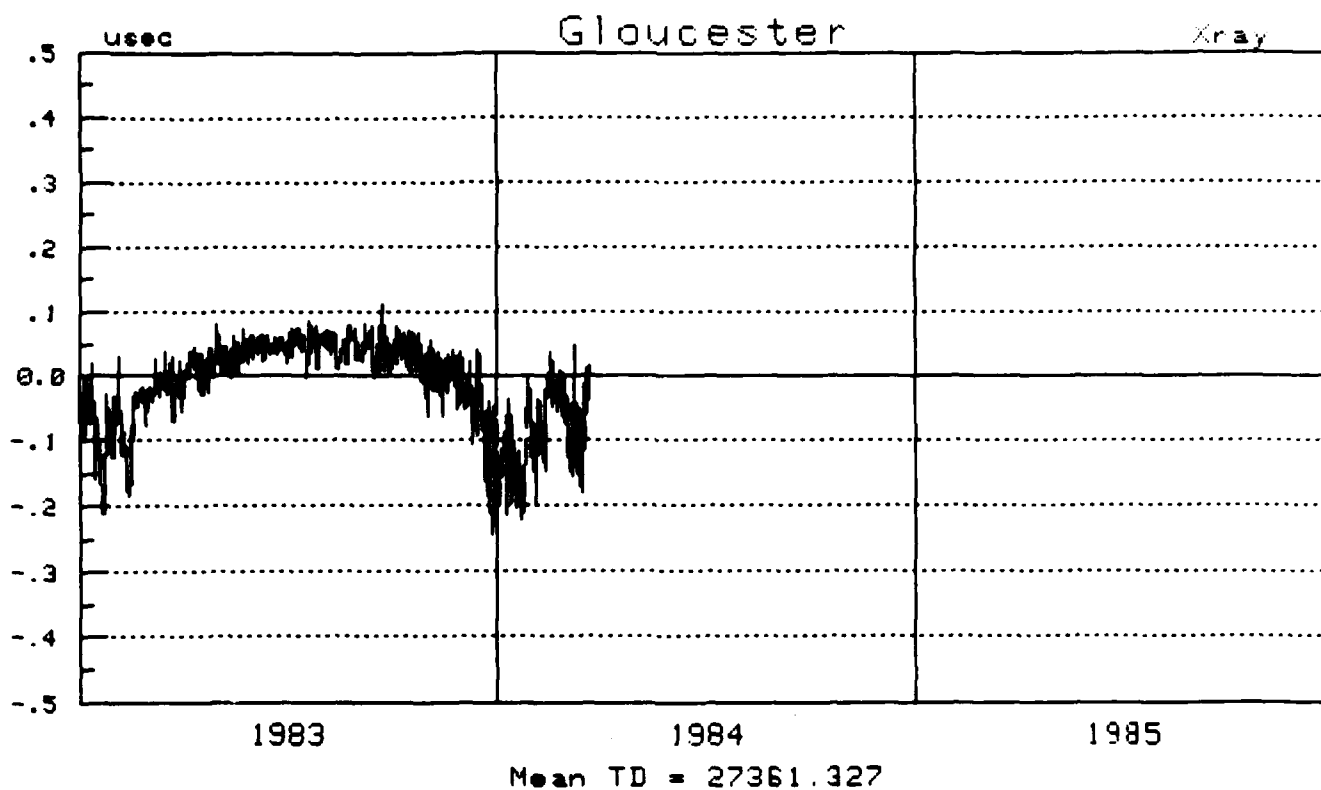
Receiving Antenna Location:

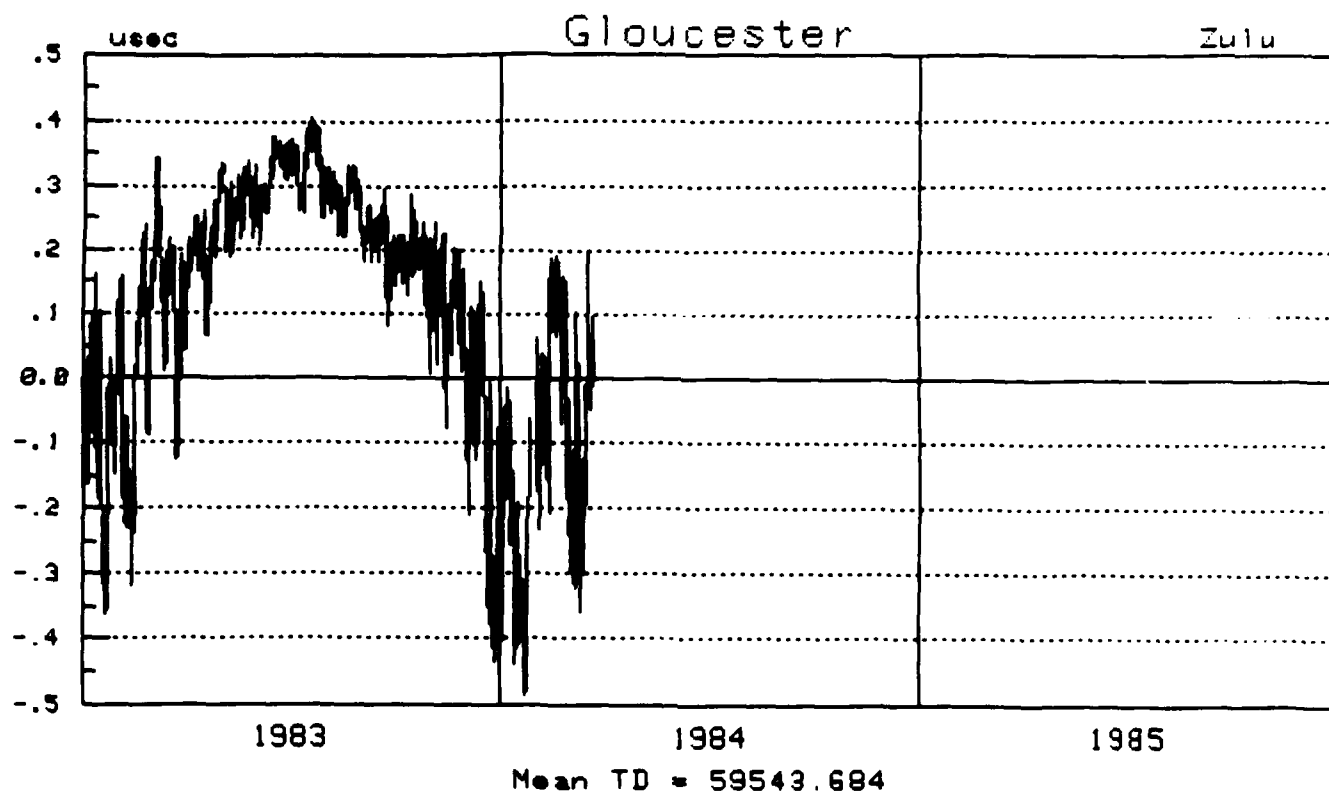
WGS 72
LAT : 39 53 57.22N
LON : 75 07 40.77W

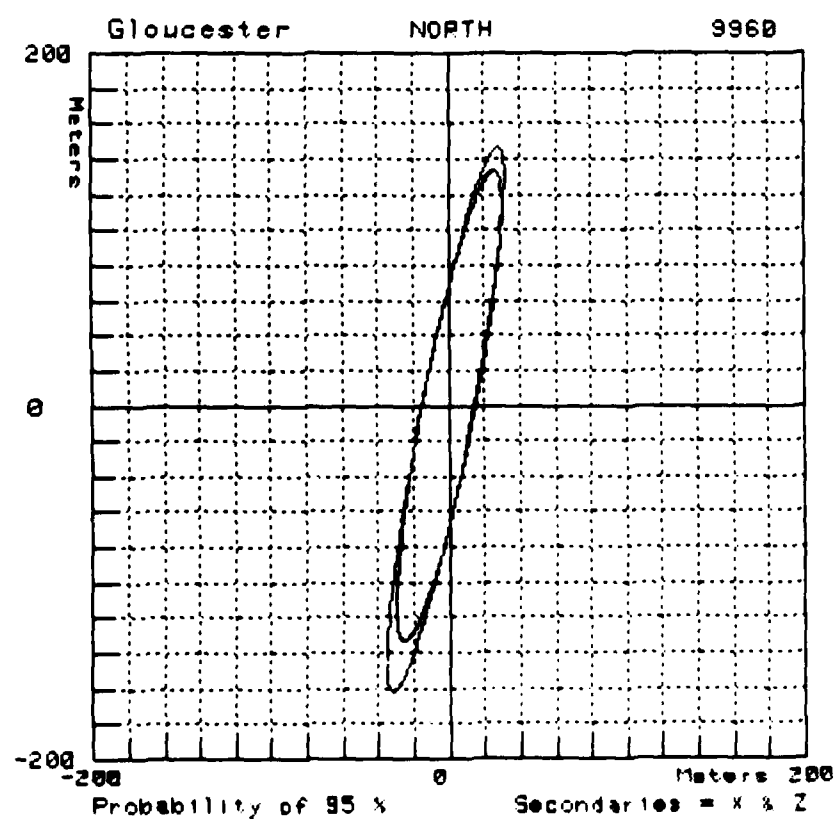
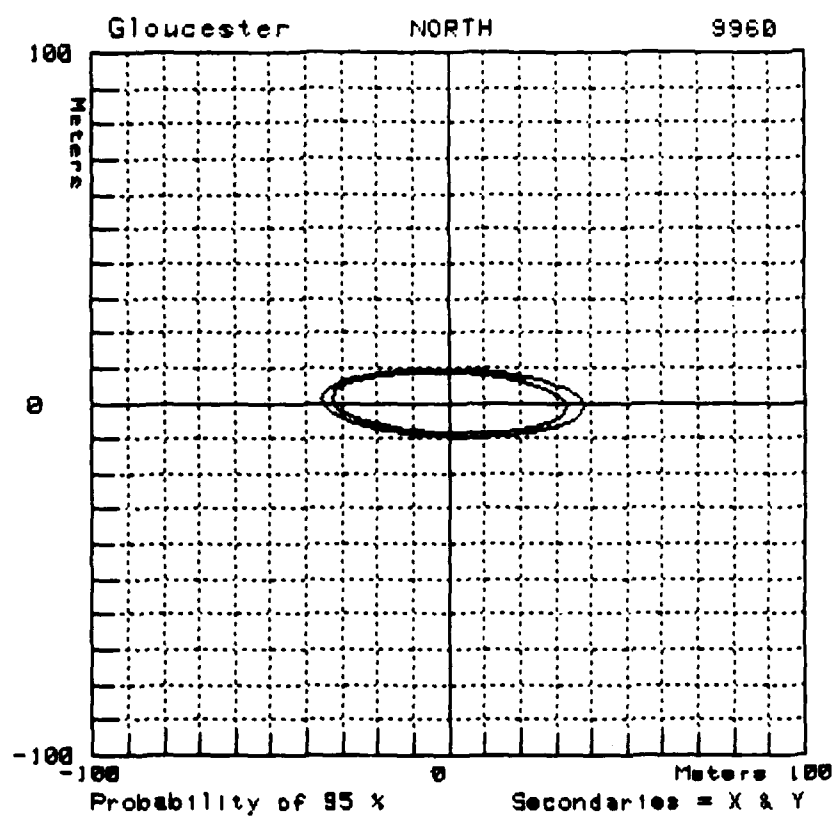
NAD 27
LAT : 39 53 57.16N
LON : 75 07 41.57W

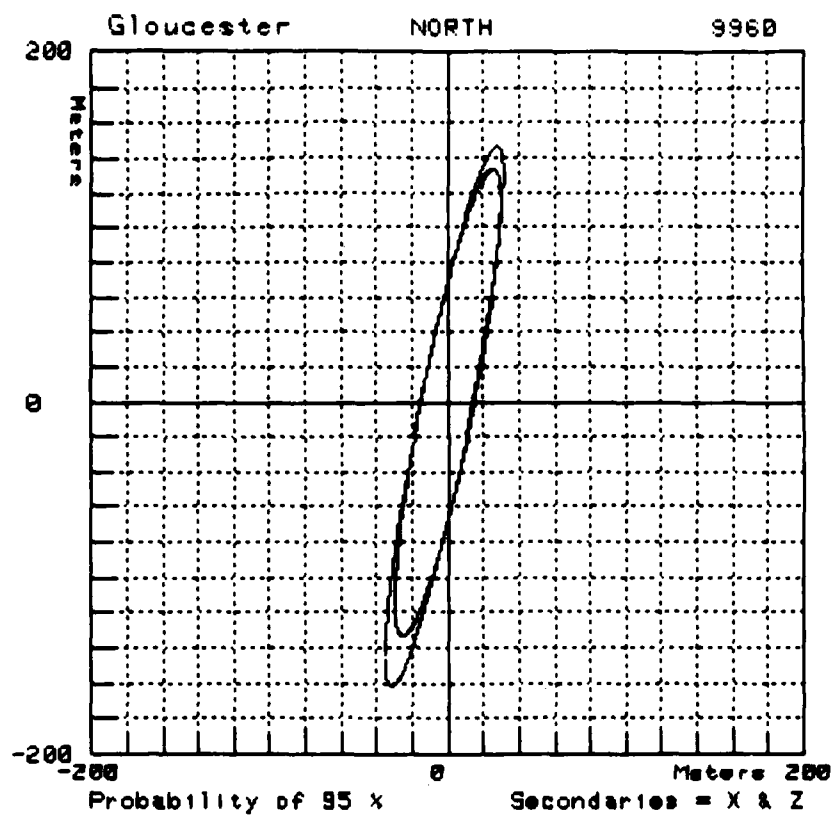
Positioning System
GPS

X-LOP: 202.7 deg	Gradients: 676 ft/usec
Y-LOP: 268.9 deg	Gradients: 534 ft/usec
Z-LOP: 304.9 deg	Gradients: 950 ft/usec









HMS SITE INFORMATION

IROQUOIS LOCK, ONTARIO, CANADA

Monitor: Type-D
Monitor Equipment: HP-9915 and LC-404
Data Collection: 11 September 1982 - 03 October 1983

GRI: 9960 U.S. Northeast Chain

TDW: 14965.354
TDX: 28053.309

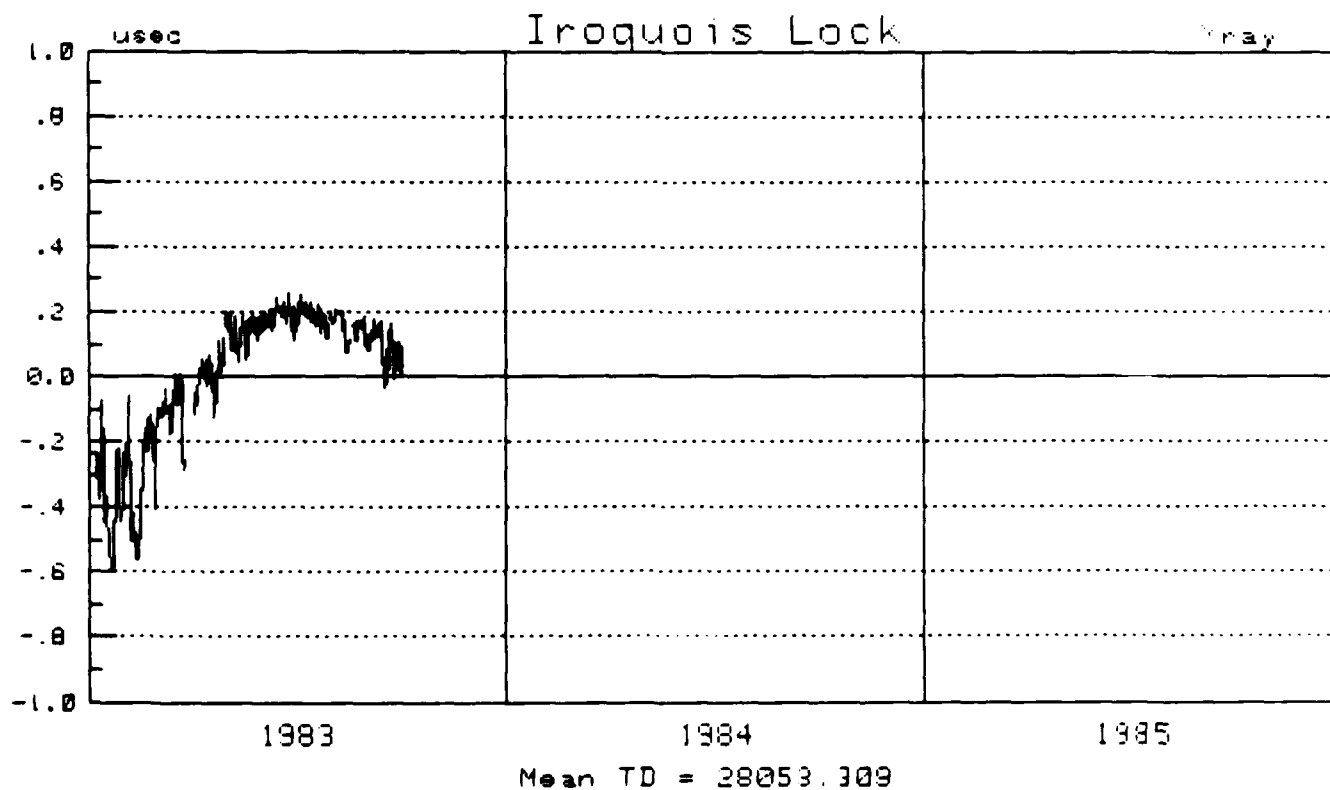
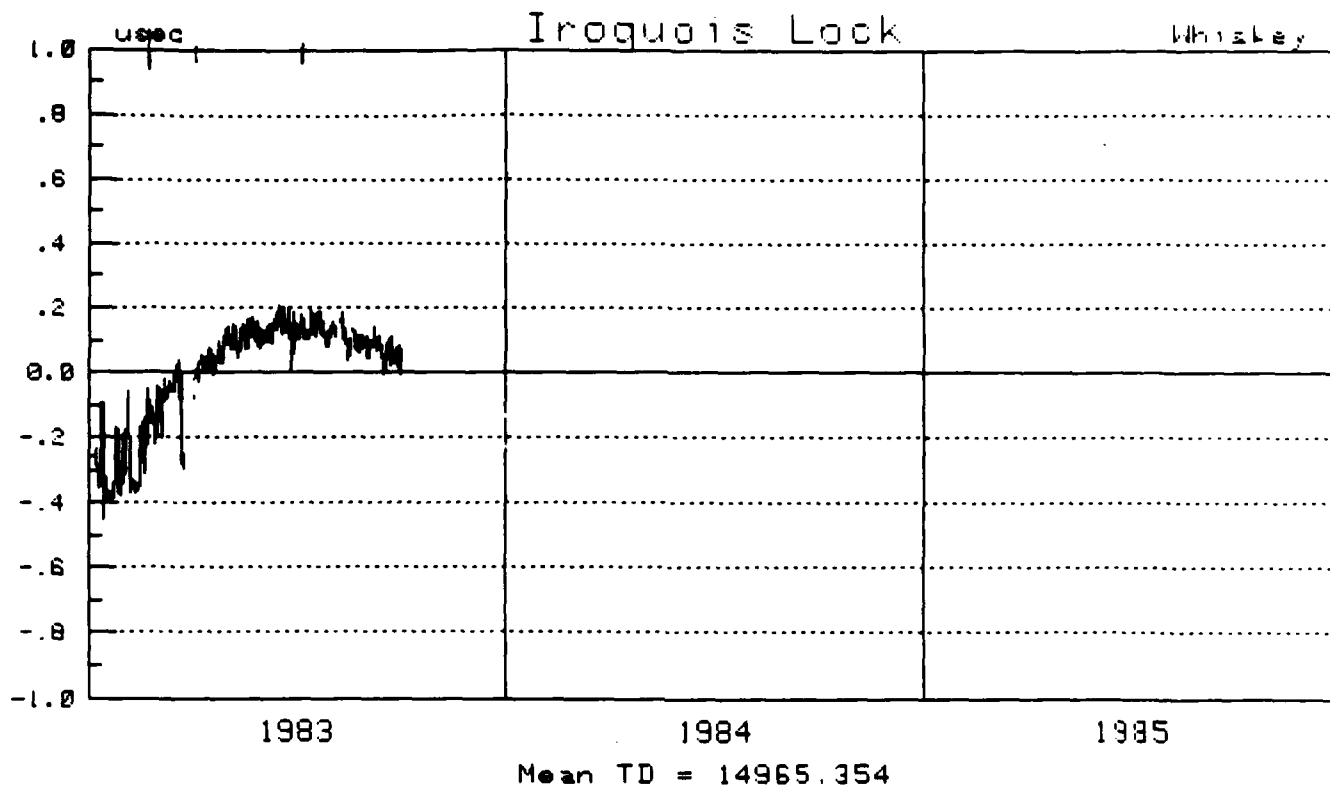
Receiving Antenna Location:

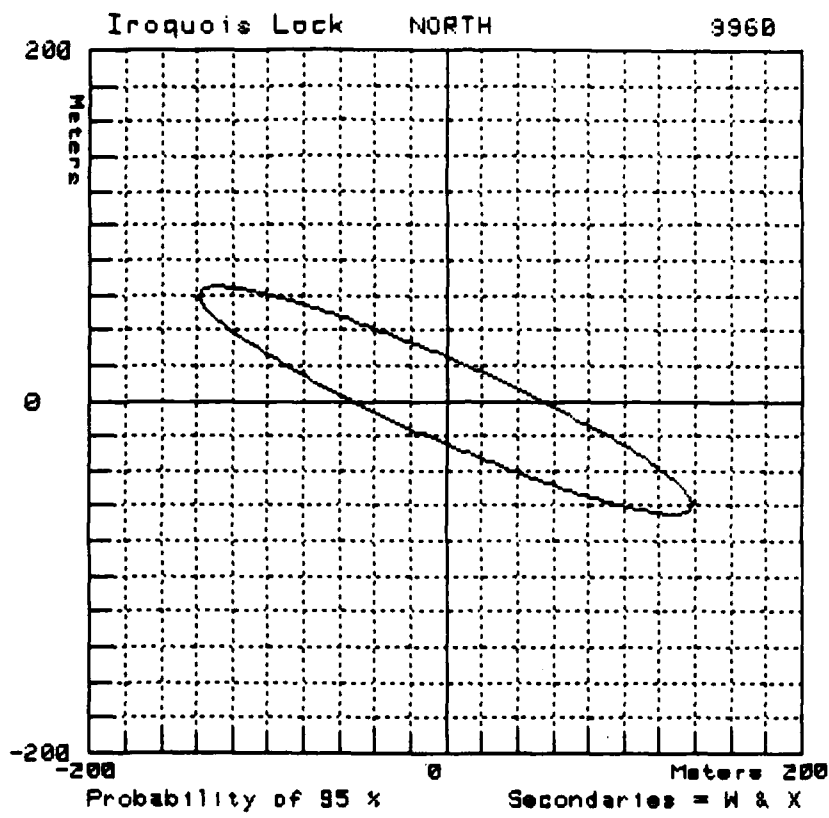
WGS 72
LAT : 44 49 55.9 N
LON : 75 18 42.2 W

NAD 27
LAT : 44 49 56 N
LON : 75 18 43 W

Positioning System
From Nautical Chart

W-LOP: 137 deg Gradients: 521 ft/usec
X-LOP: 169 deg Gradients: 787 ft/usec





HMS SITE INFORMATION

JACKMAN, MAINE

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 04 October 1984 - 06 October 1985

GRI: 9960 U.S. Northeast Chain

TDW: 12476.660
TDX: 26534.075

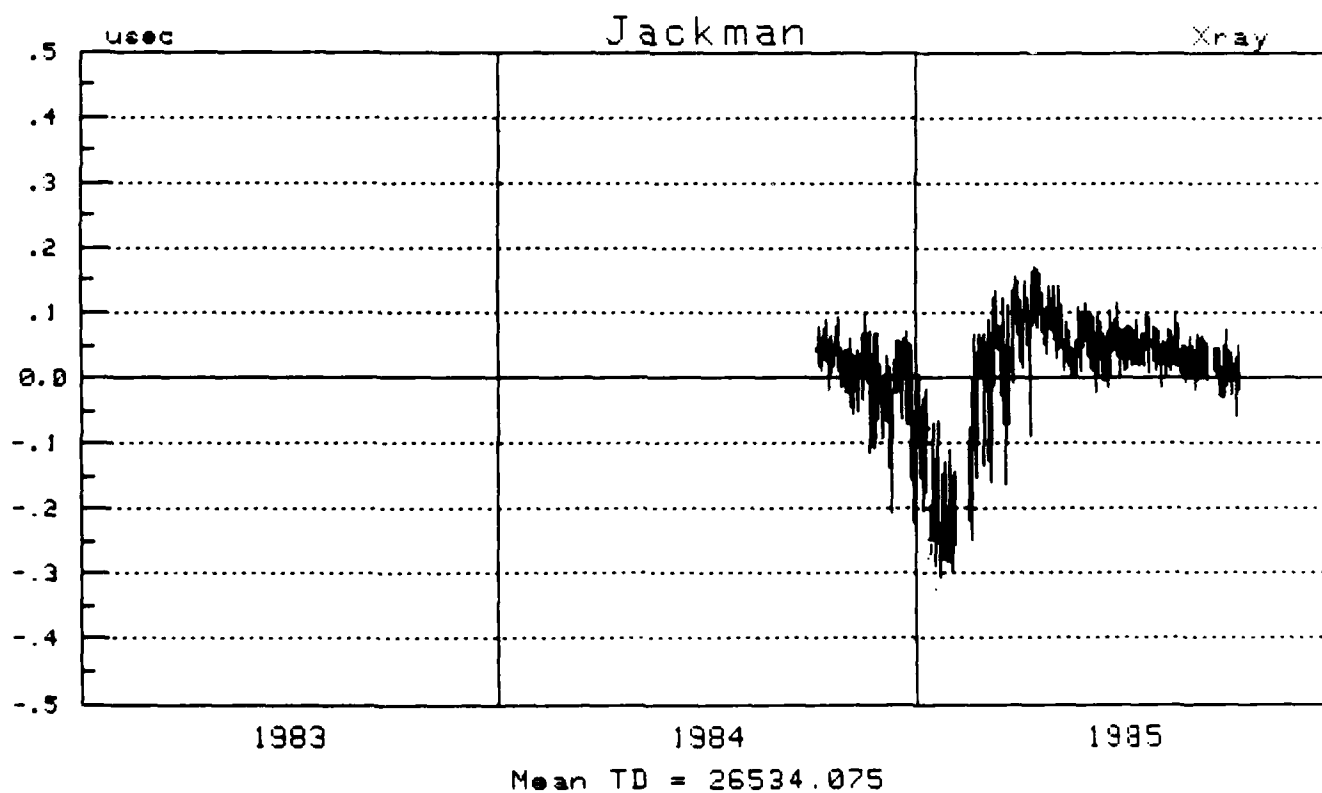
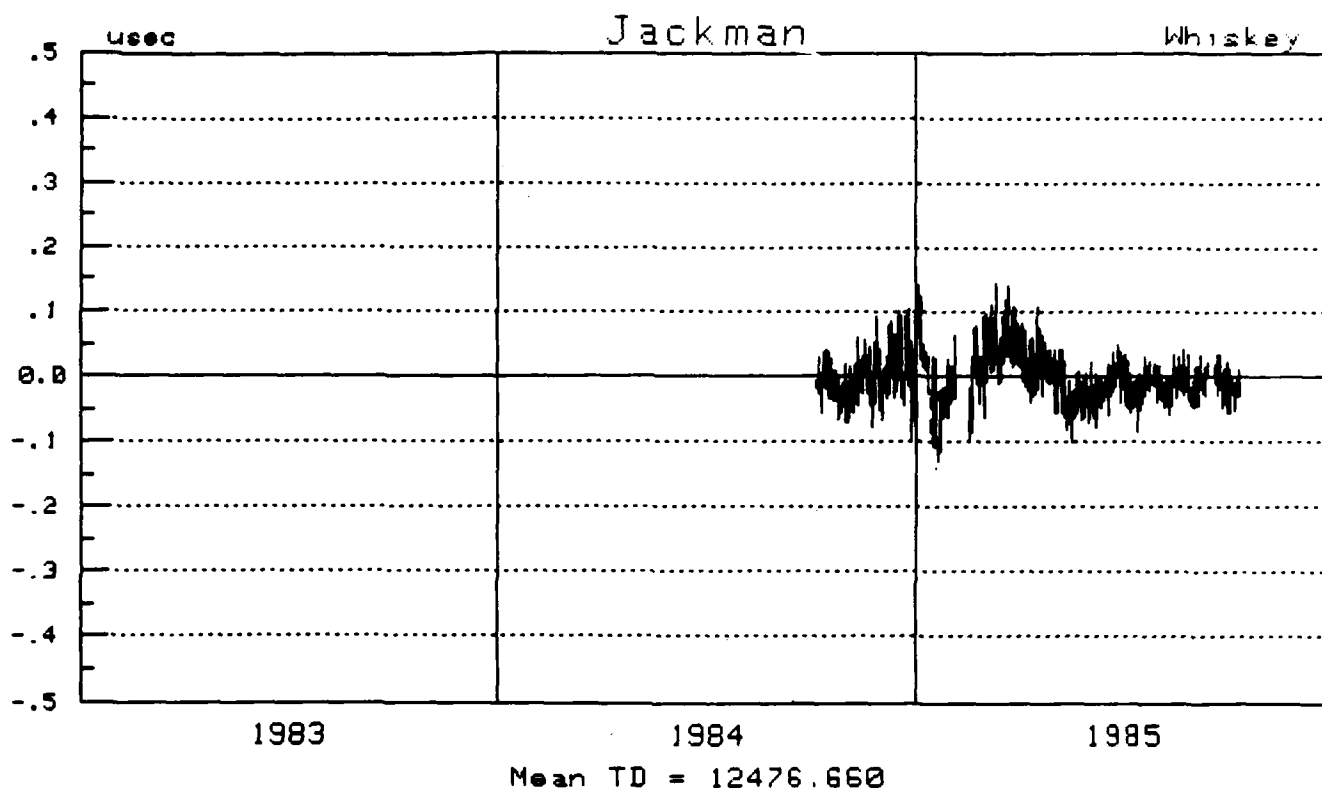
Receiving Antenna Location:

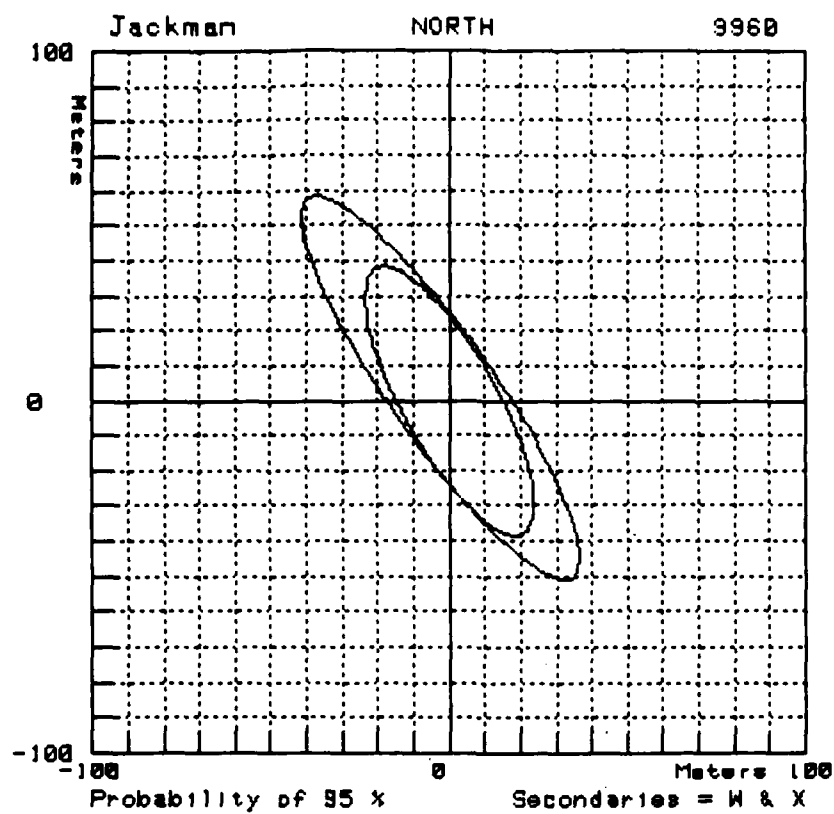
WGS 72
LAT : 45 37 59.52N
LON : 70 15 27.24W

NAD 27
LAT : 45 37 59.65N
LON : 70 15 28.73W

Positioning System
GPS

W-LOP: 146.9 deg Gradients: 493 ft/usec
X-LOP: 209.0 deg Gradients: 935 ft/usec





HMS SITE INFORMATION

LEWES, DELAWARE

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 21 September 1981 - 10 February 1986

GRI: 9960 U.S. Northeast Chain

TDX: 27160.430
TDY: 42623.759
TDZ: 59208.022

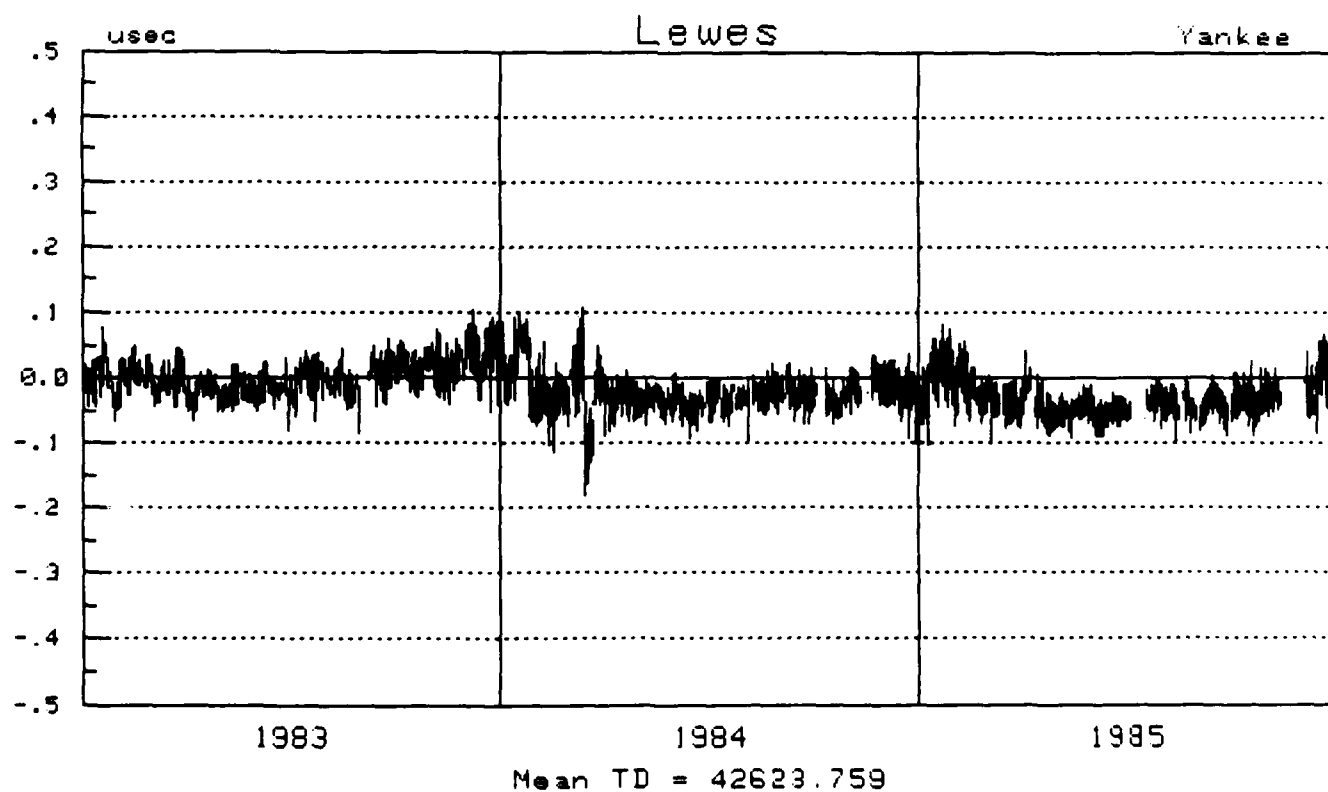
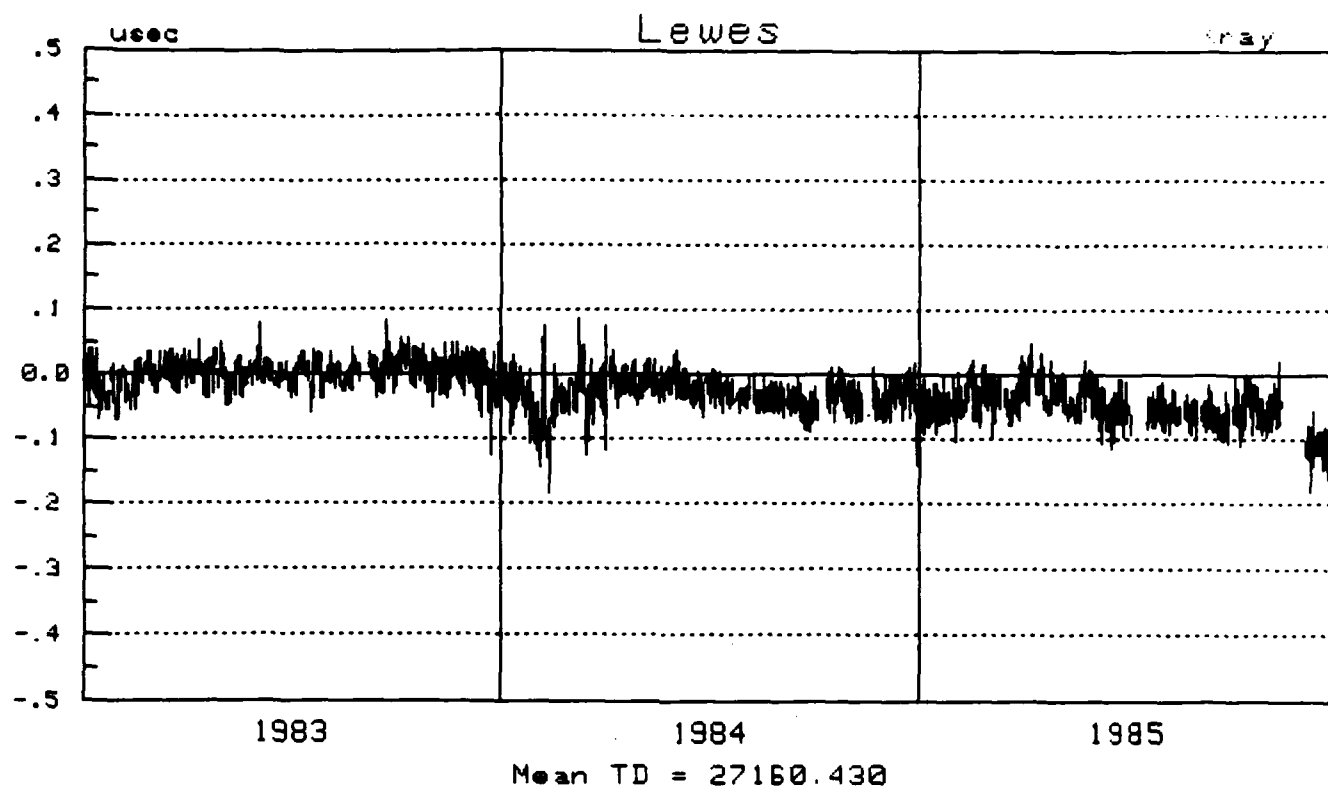
Receiving Antenna Location:

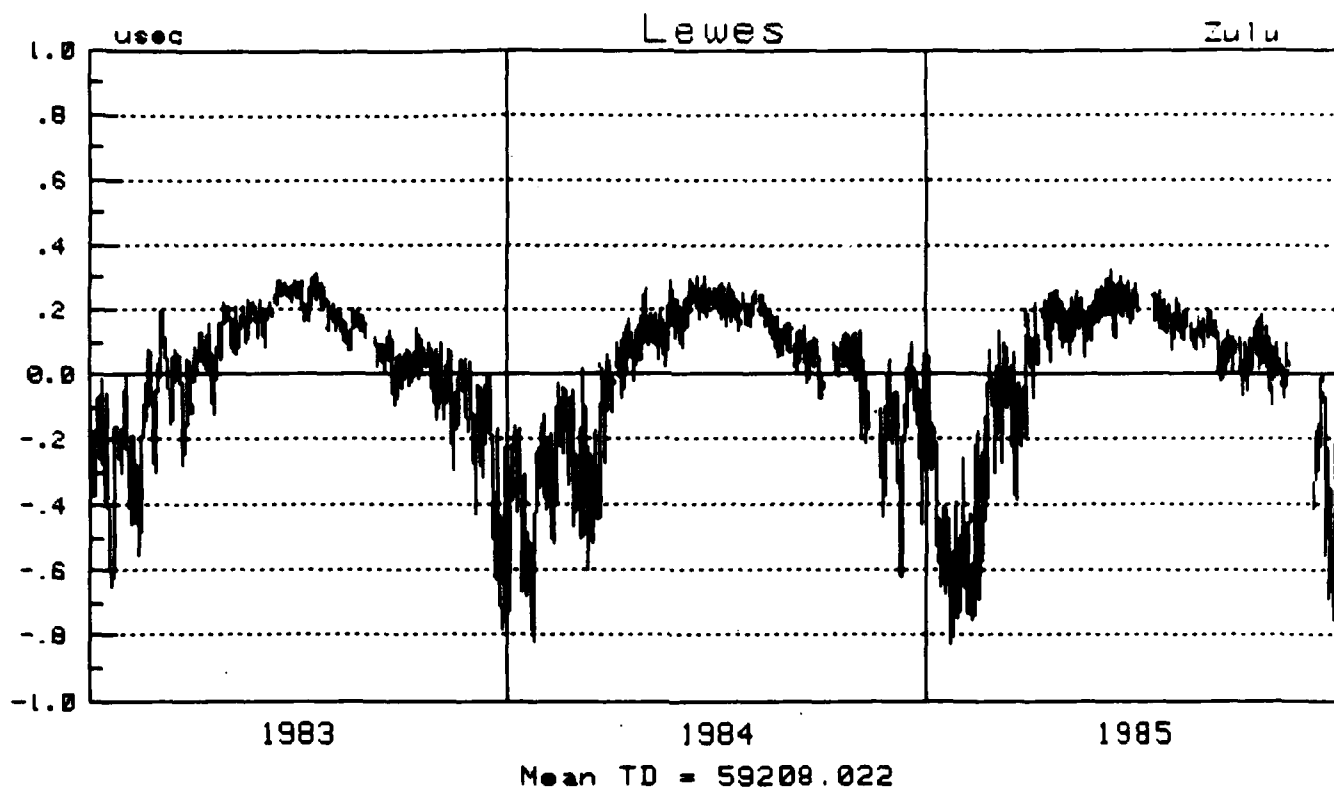
WGS 72
LAT : 38 46 51.21N
LON : 75 07 13.86W

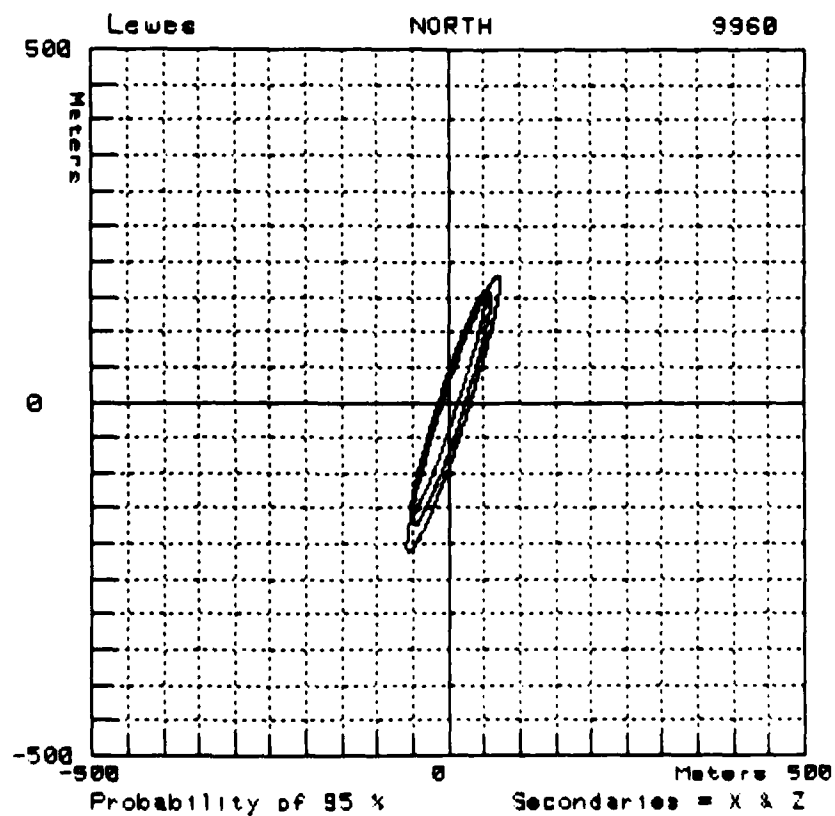
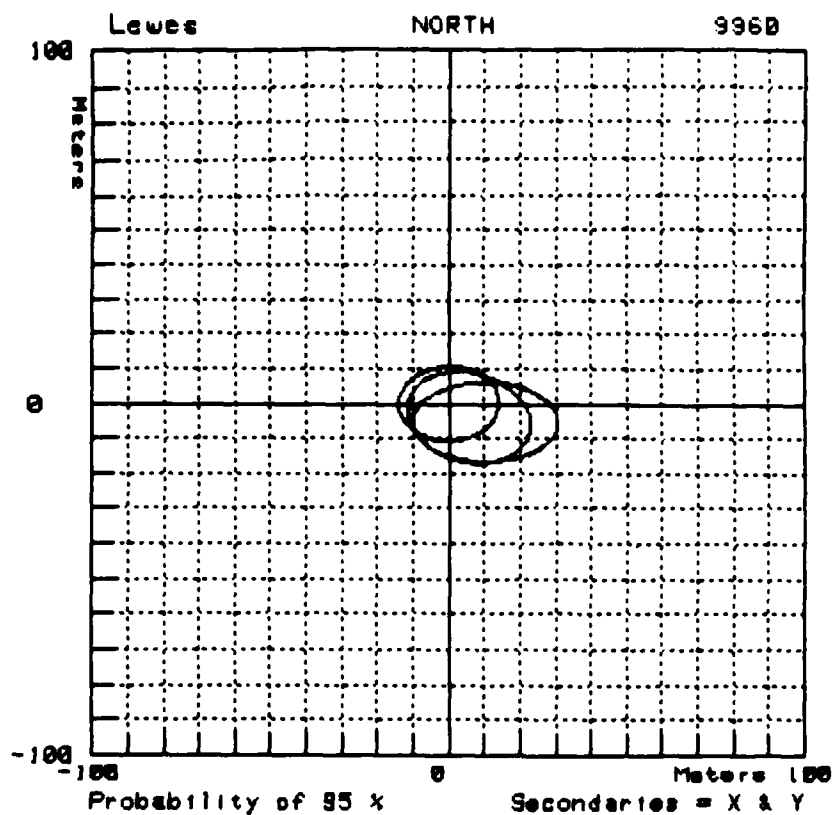
NAD 27
LAT : 38 46 51.10N
LON : 75 07 14.65W

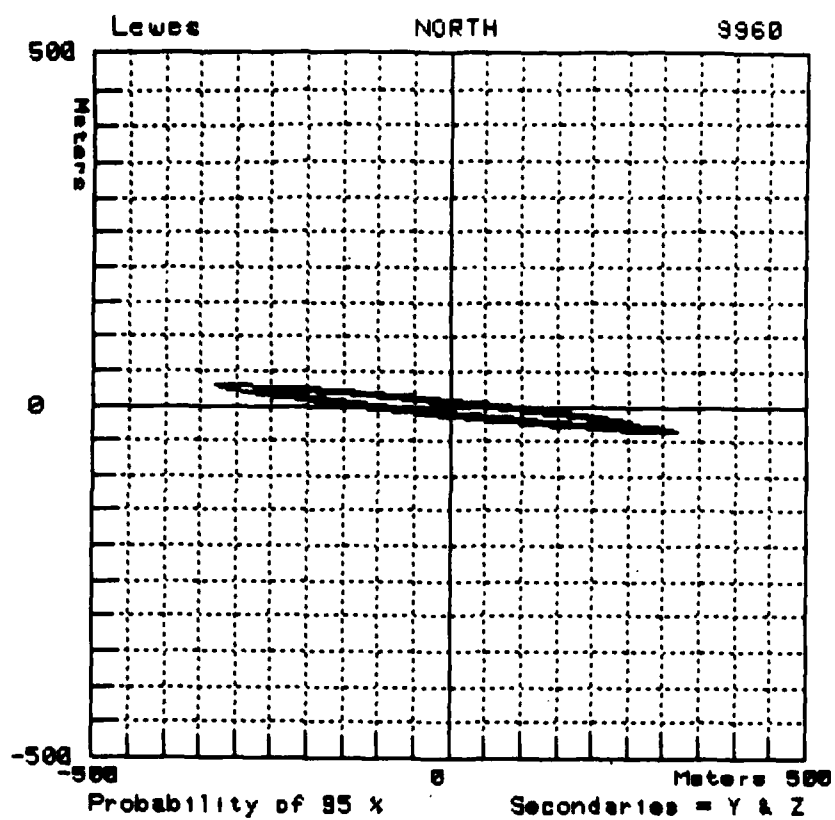
Positioning System
GPS

X-LOP: 199.3 deg	Gradients: 816 ft/usec
Y-LOP: 274.3 deg	Gradients: 530 ft/usec
Z-LOP: 311.3 deg	Gradients: 954 ft/usec









HMS SITE INFORMATION

MASSENA, NEW YORK

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 21 October 1981 - 5 October 1985

GRI: 9960 U.S. Northeast Chain

TDW: 14721.689
TDX: 27891.493
TDY: 45372.039
TDZ: 60122.050

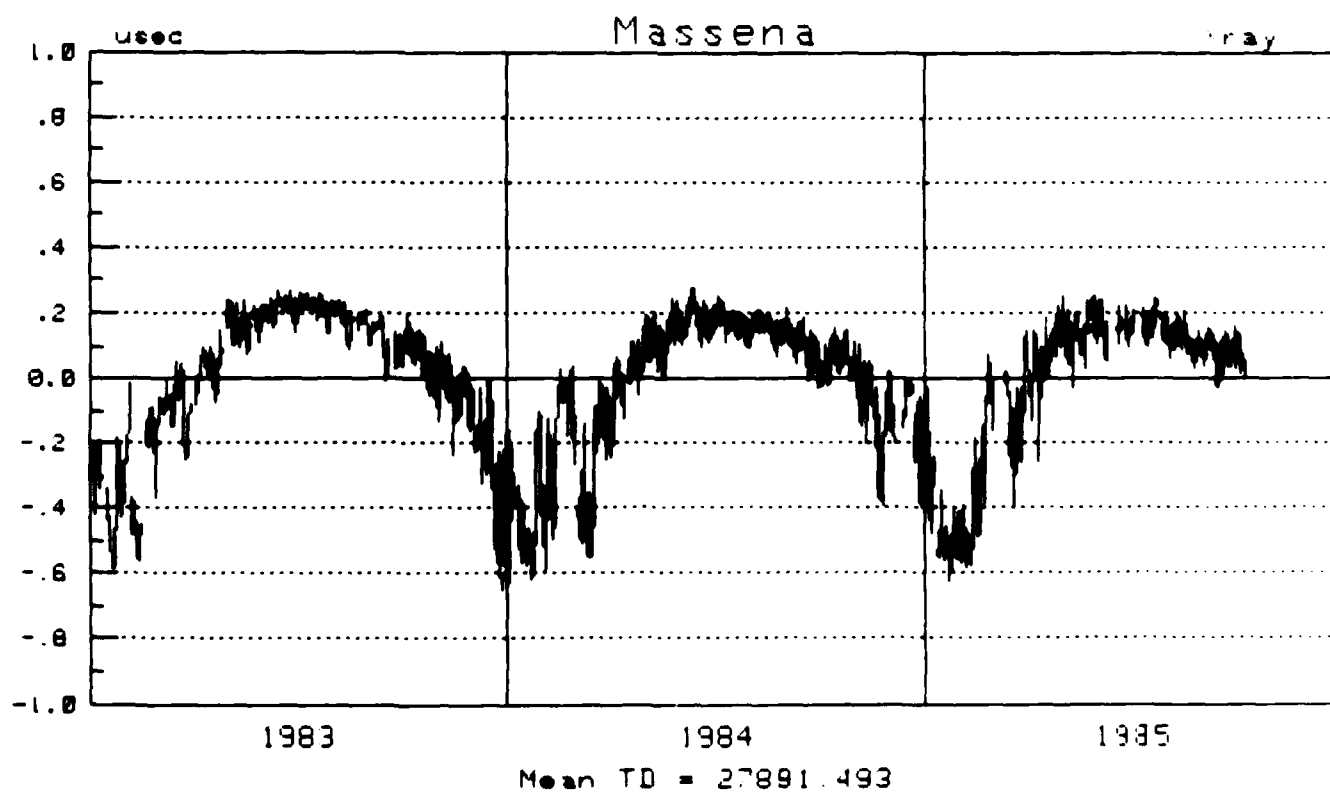
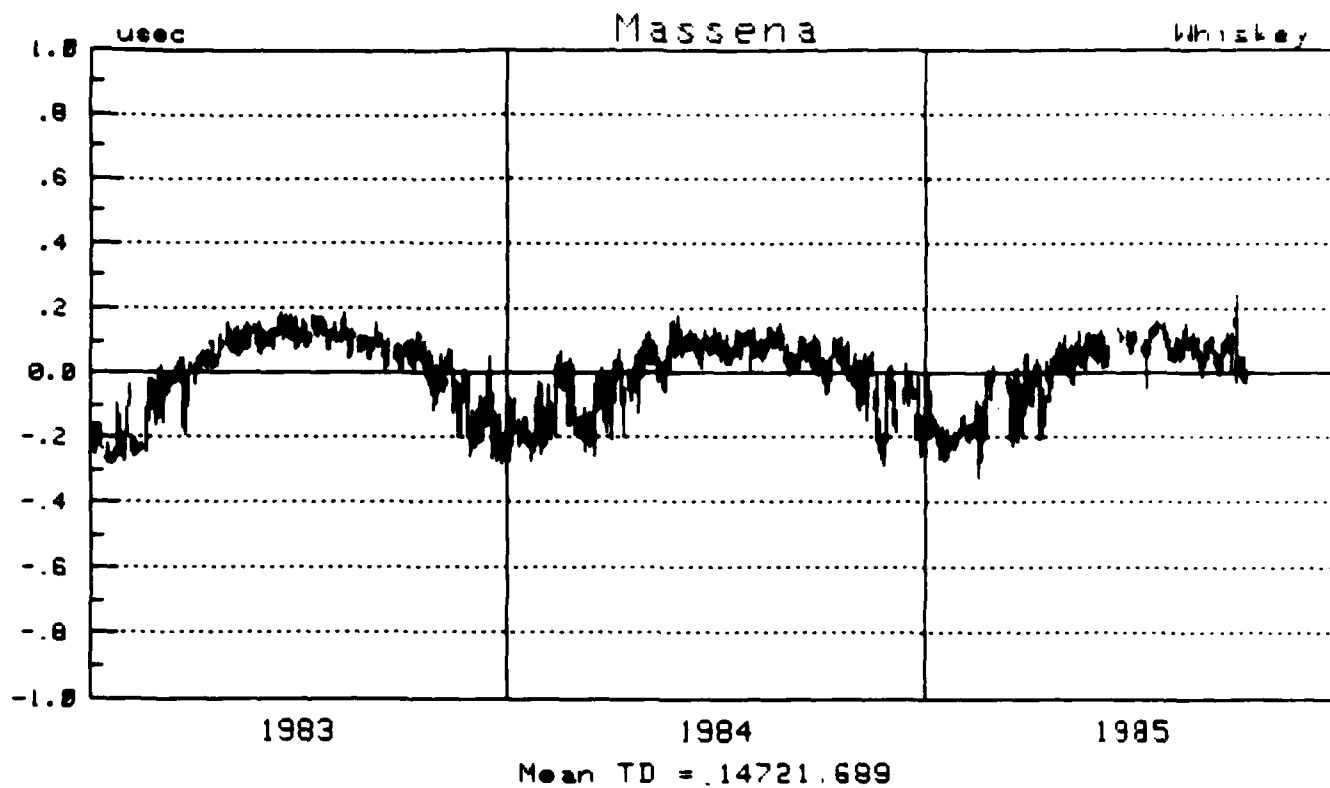
Receiving Antenna Location:

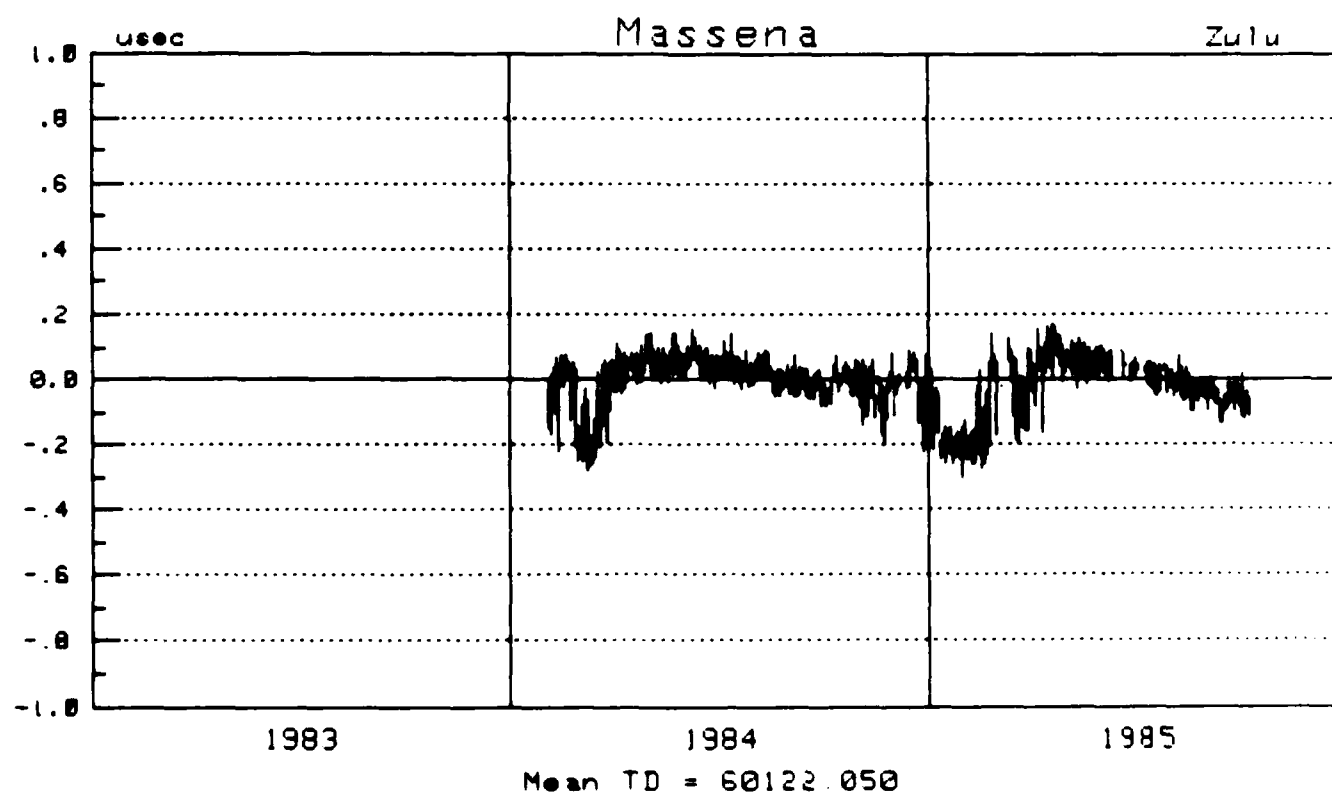
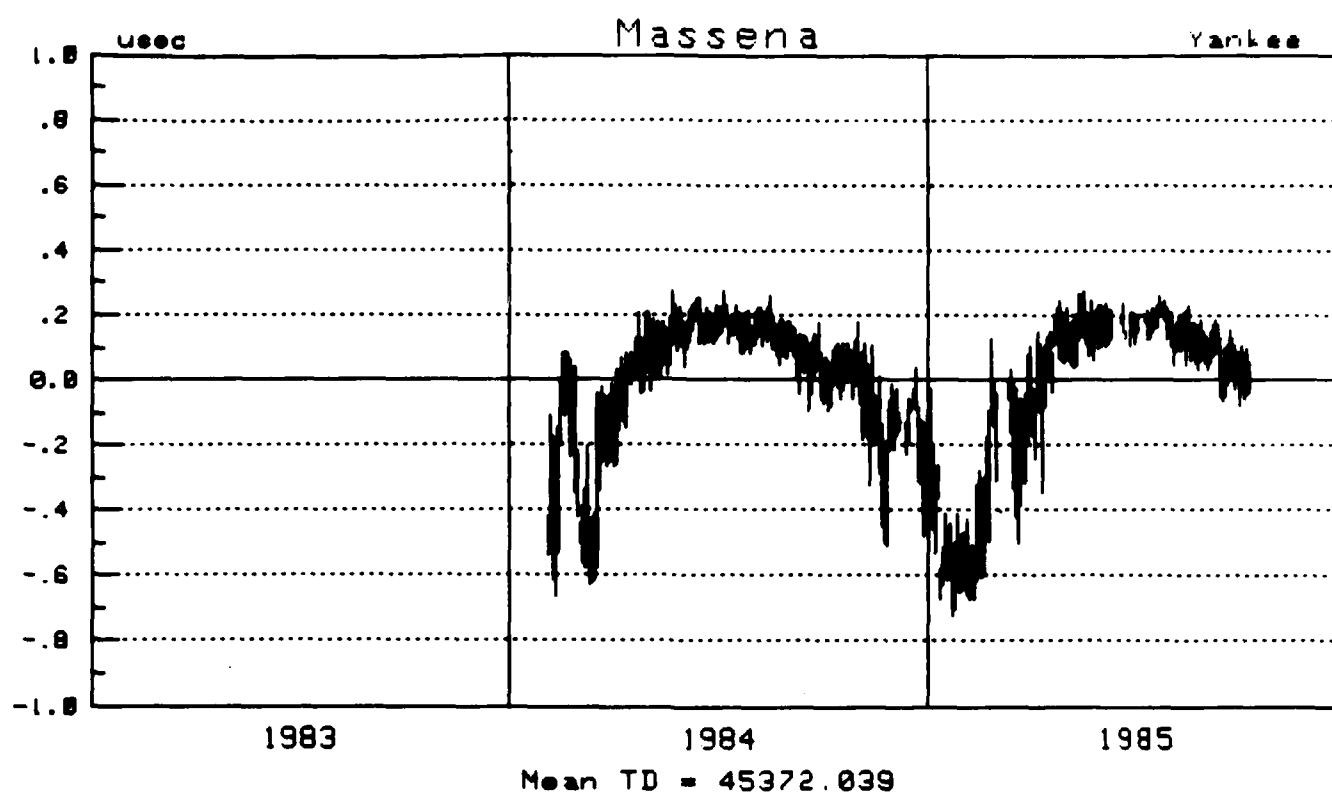
WGS 72
LAT : 44 58 45.38N
LON : 74 51 06.29W

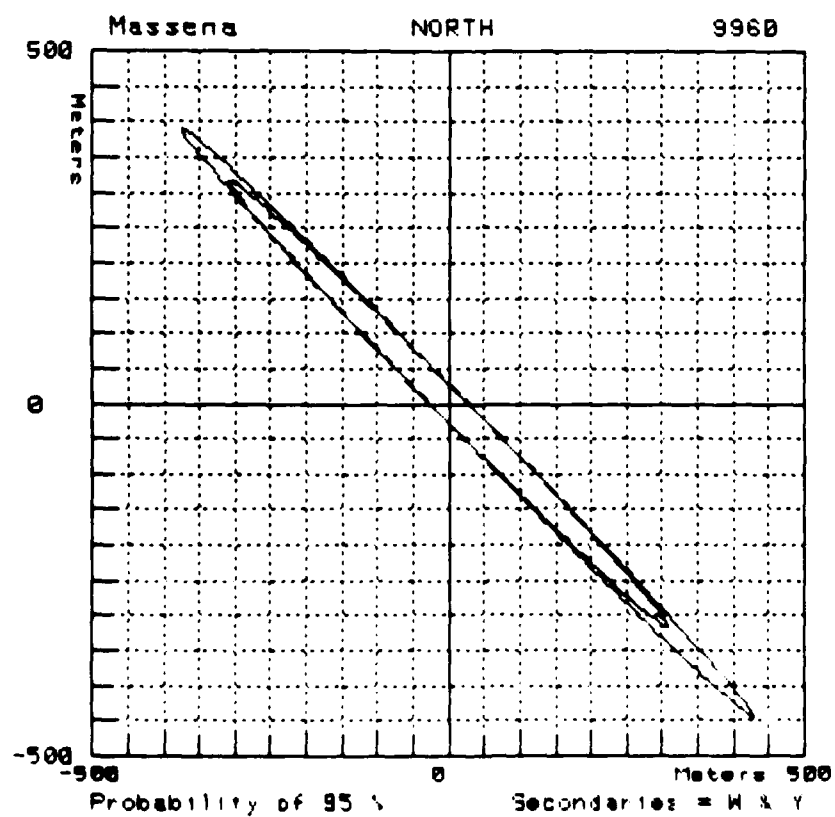
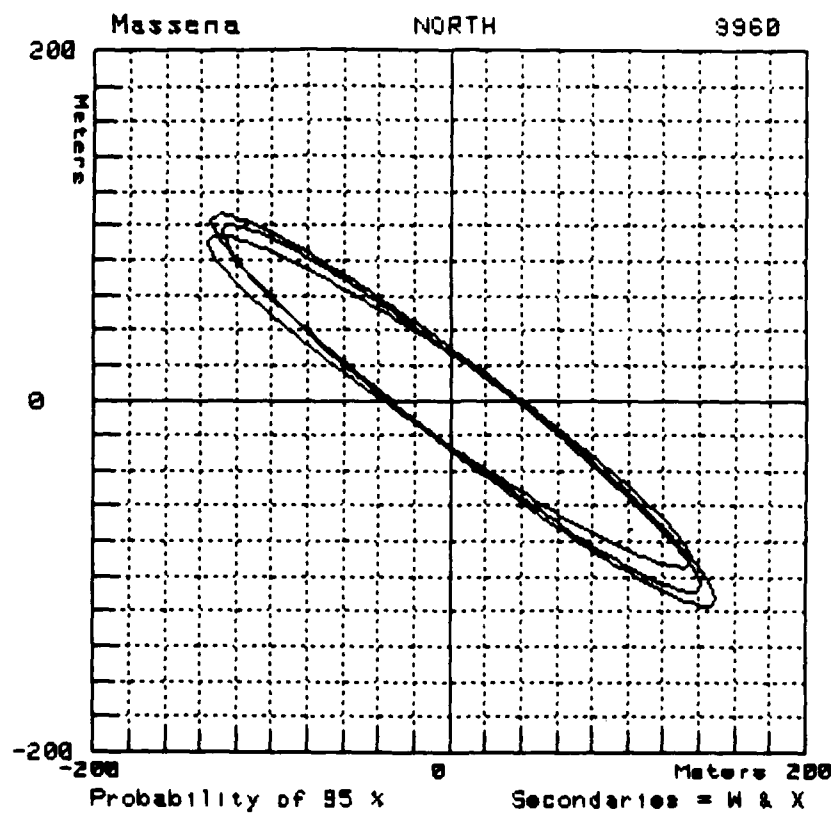
NAD 27
LAT : 44 58 45.46N
LON : 74 51 07.19W

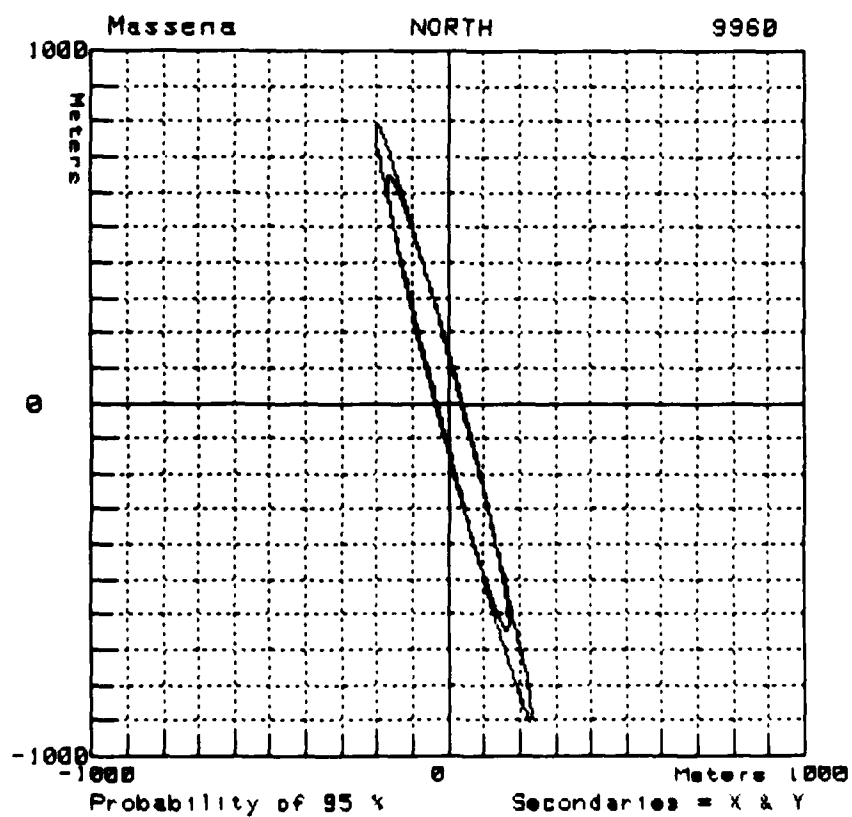
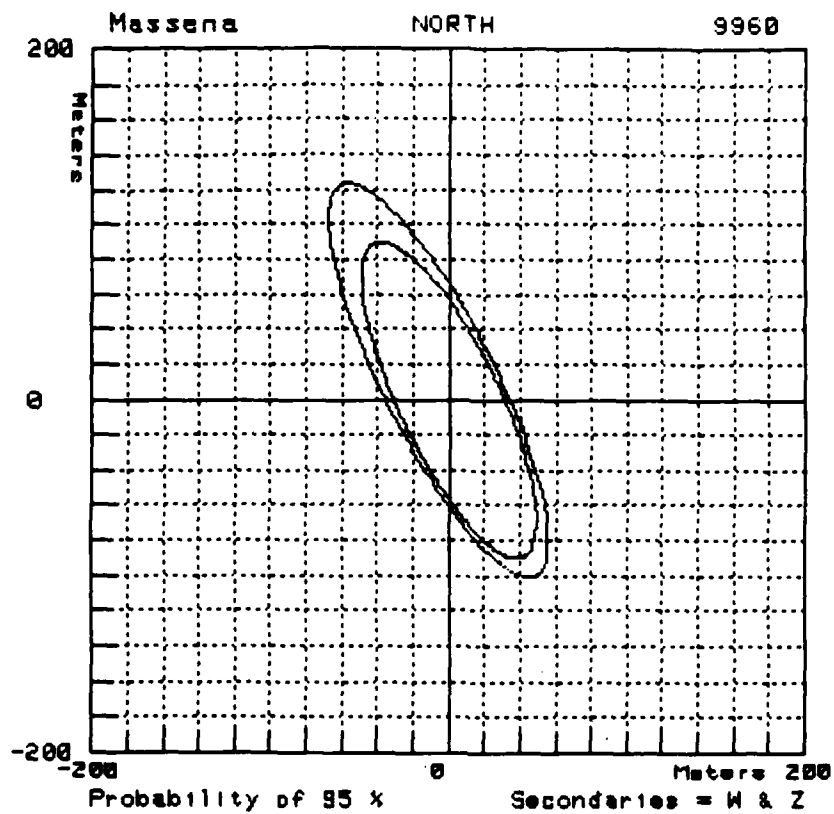
Positioning System
GPS

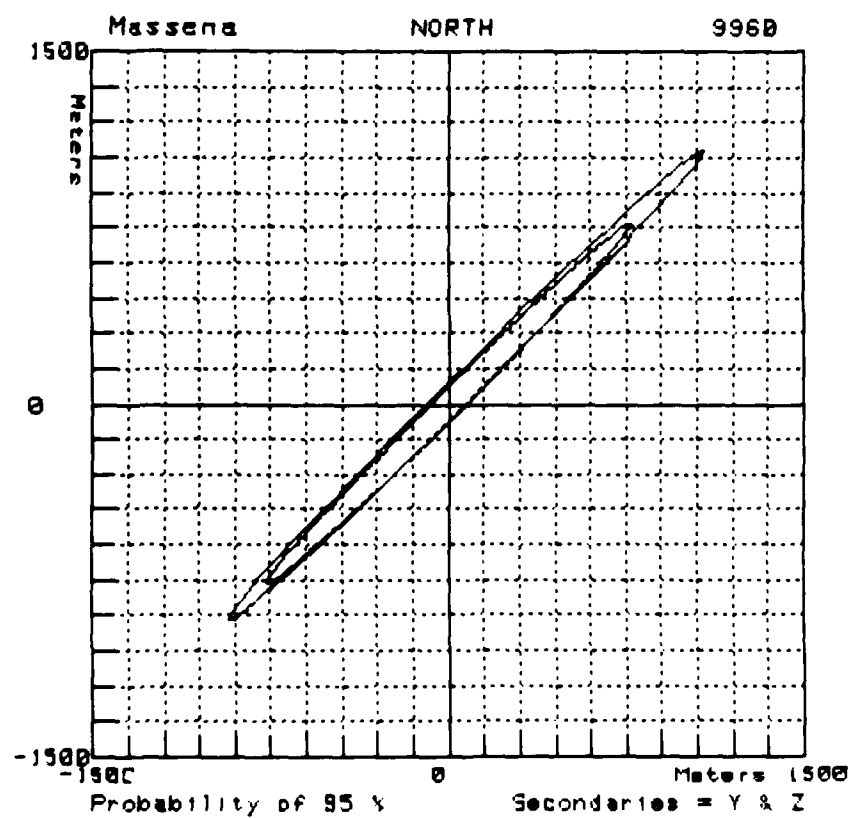
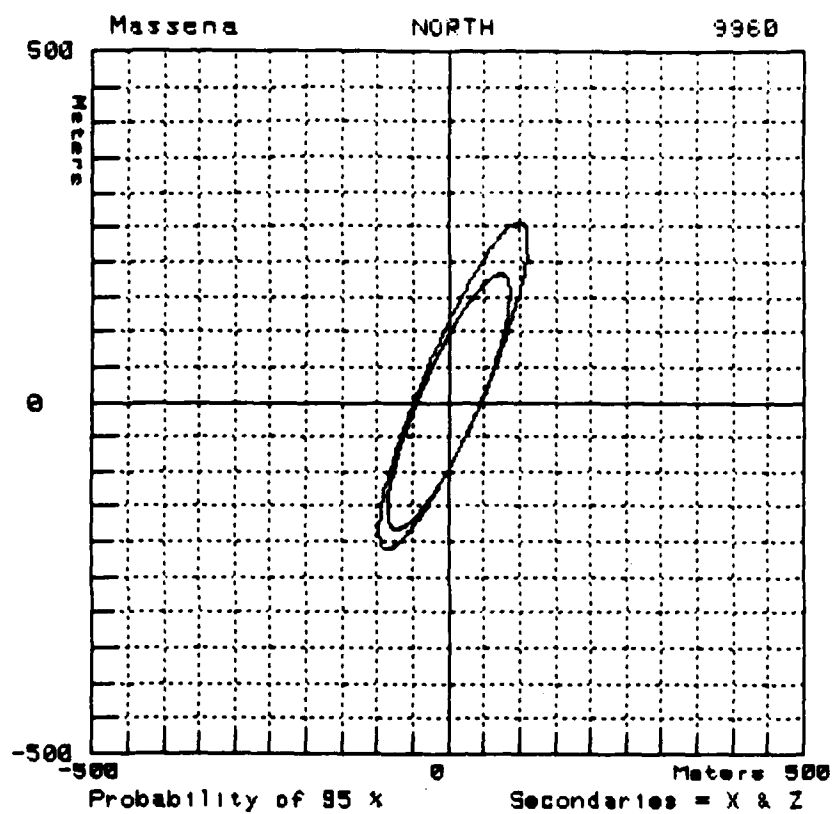
W-LOP: 139.8 deg	Gradients: 514 ft/usec
X-LOP: 173.7 deg	Gradients: 778 ft/usec
Y-LOP: 203.1 deg	Gradients: 2876 ft/usec
Z-LOP: 229.3 deg	Gradients: 1774 ft/usec











HMS SITE INFORMATION

NAHANT, MASSACHUSETTS

Monitor: Type-C
Monitor Equipment: LC-404 and PCM-12
Data Collection: 25 September 1981 - 27 March 1984

GRI: 9960 U.S. Northeast Chain

TDW: 13979.426
TDX: 25843.843
TDY: 44303.674

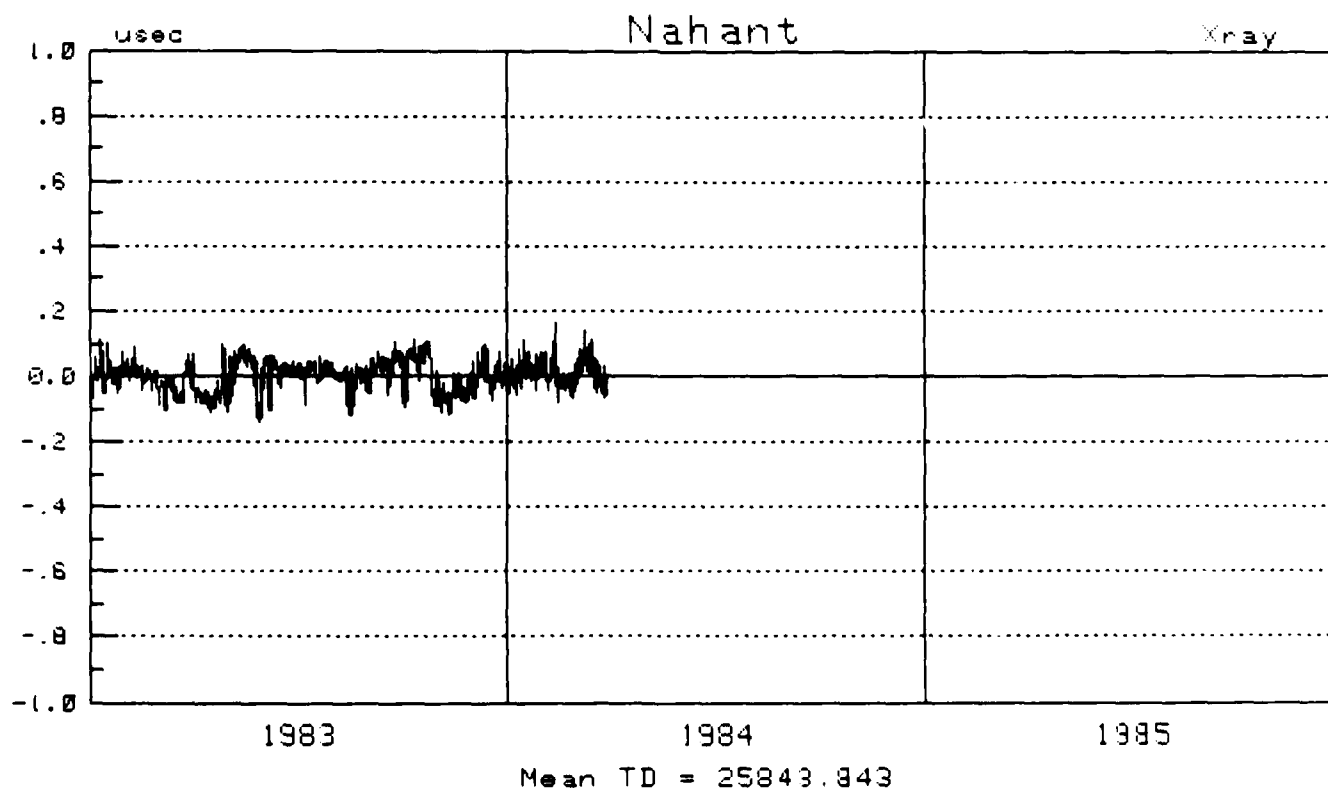
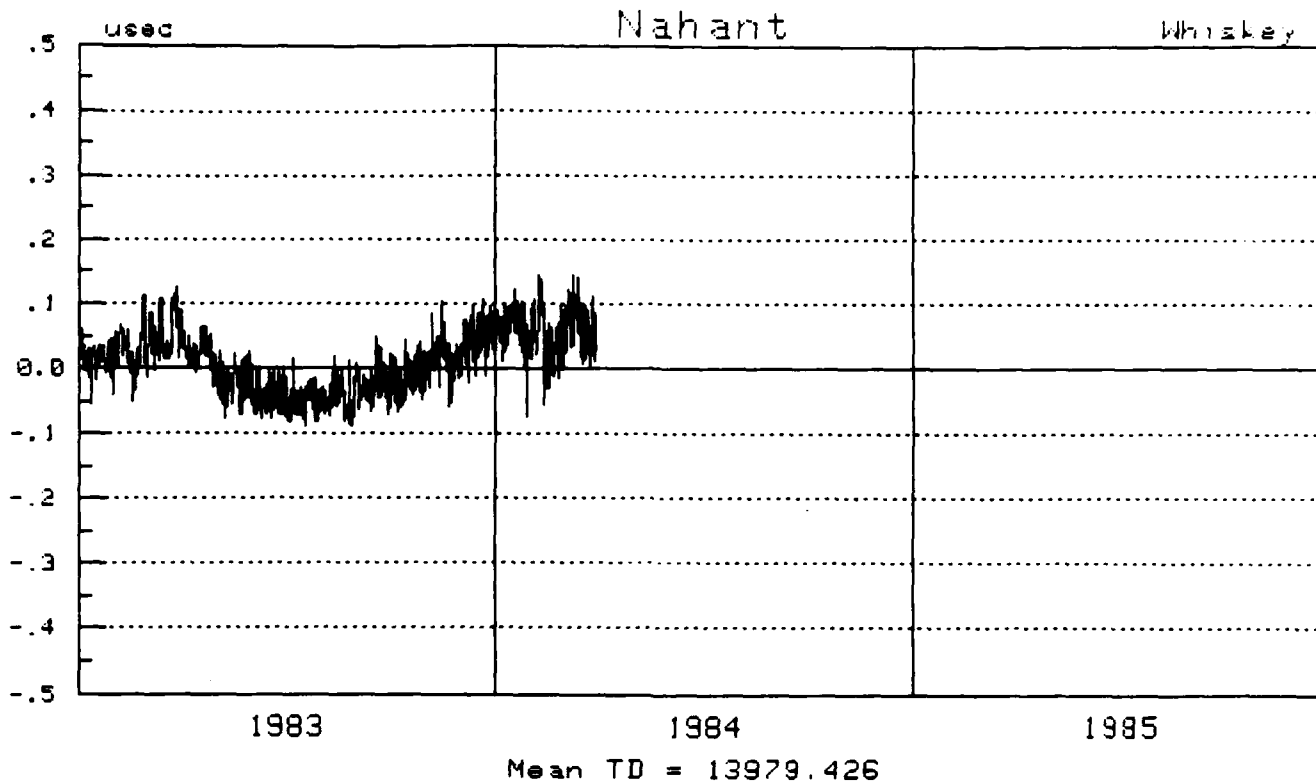
Receiving Antenna Location:

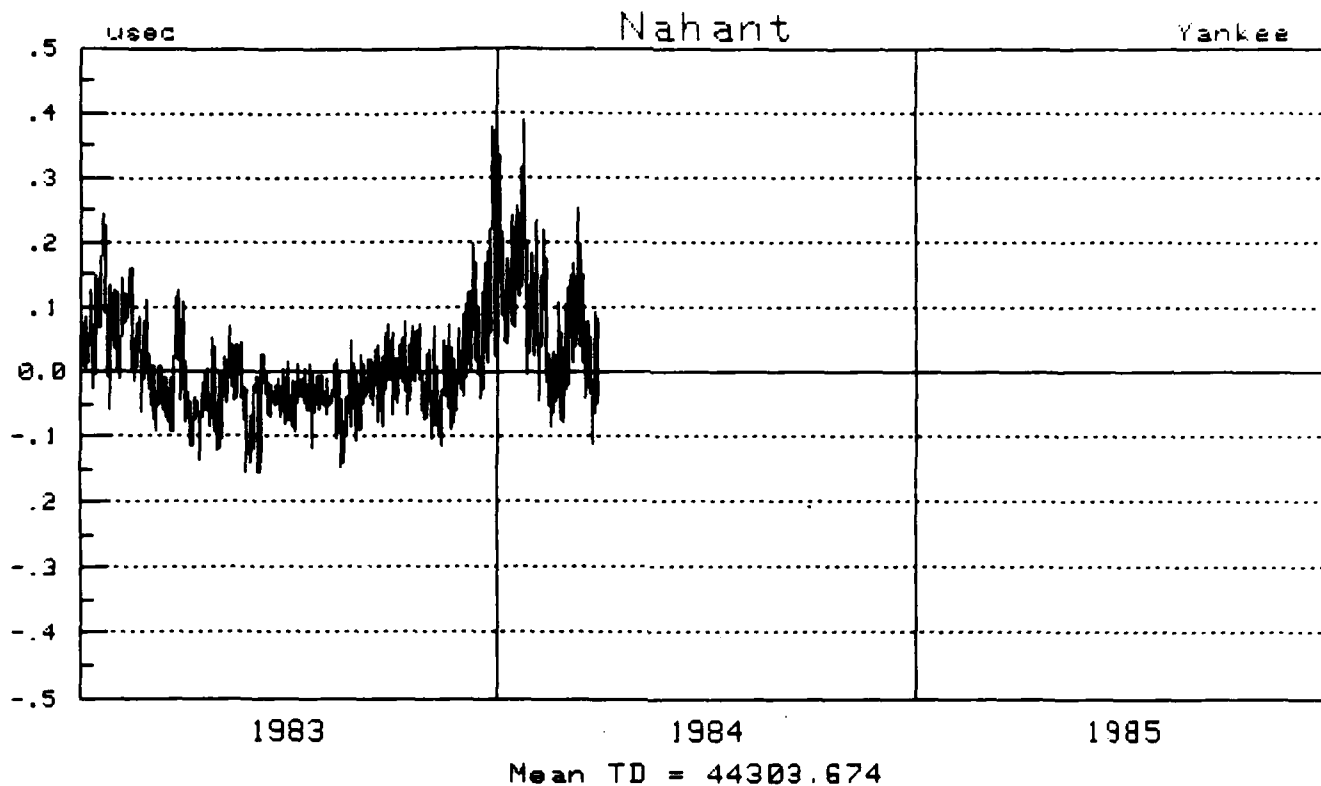
WGS 72
LAT : 42 25 5.28N
LON : 70 54 26.34W

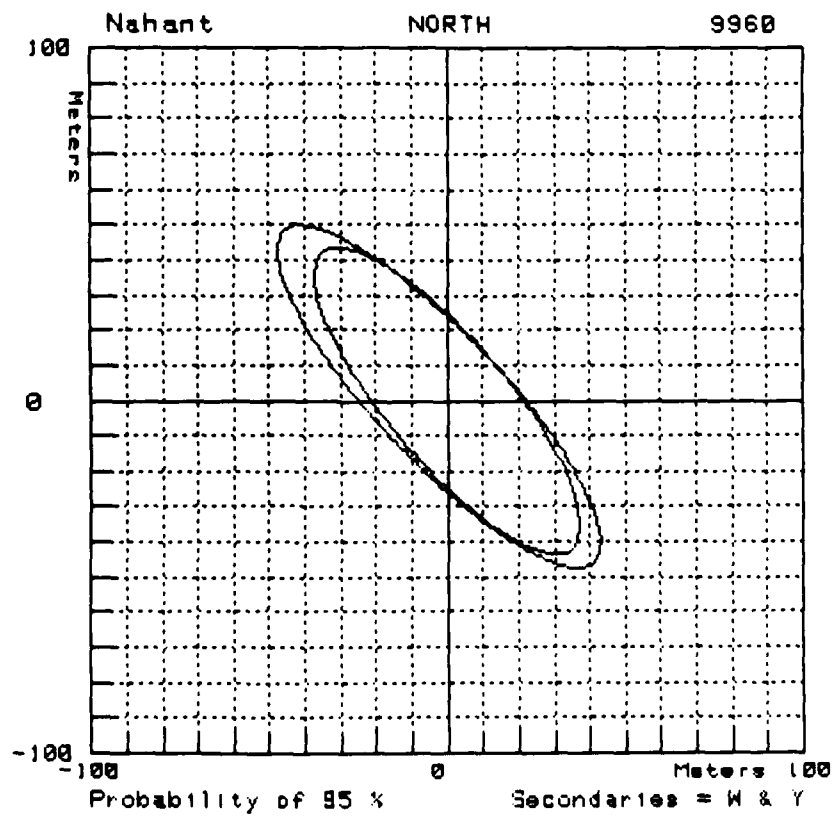
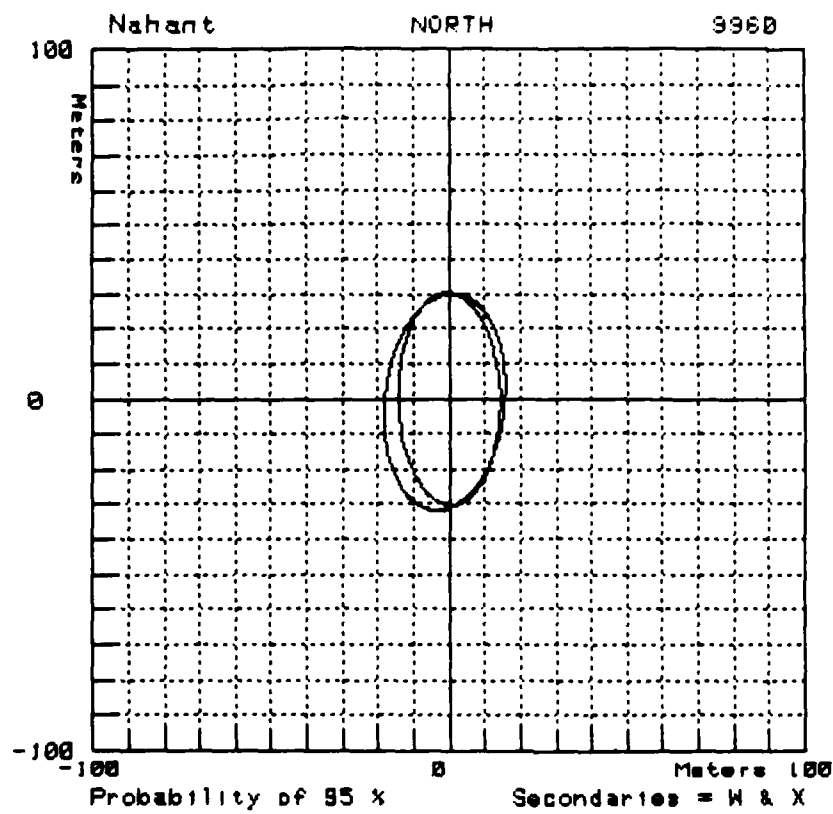
NAD 27
LAT : 42 25 5.35N
LON : 70 54 27.68W

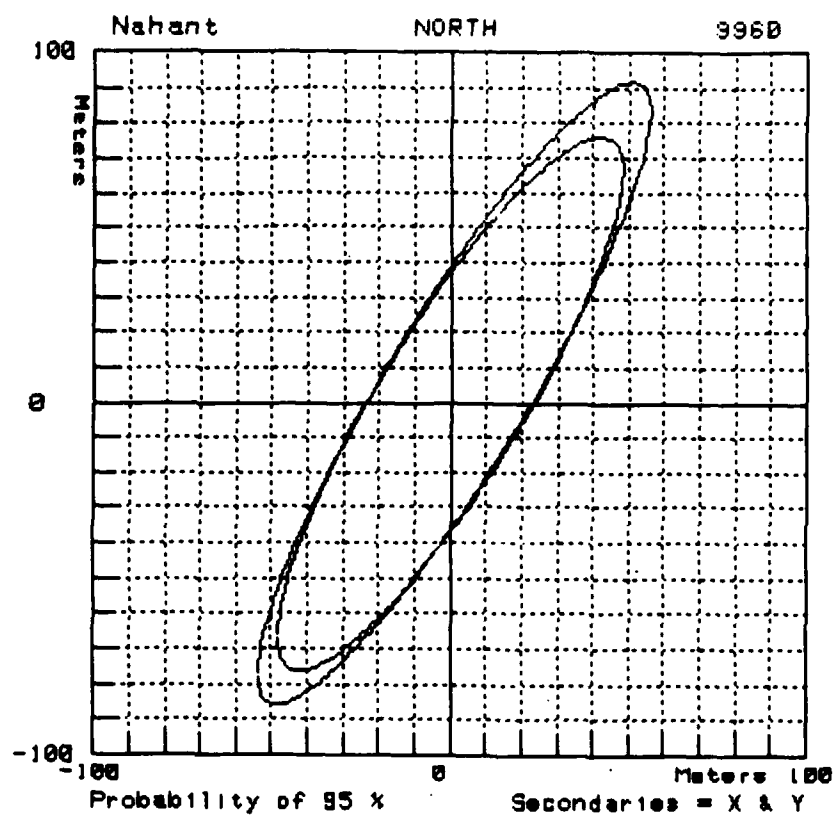
Positioning System
GPS

W-LOP: 150.3 deg	Gradients: 604 ft/usec
X-LOP: 212.4 deg	Gradients: 549 ft/usec
Y-LOP: 245.7 deg	Gradients: 981 ft/usec









HMS SITE INFORMATION

NEWPORT, VERMONT

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 23 August 1984 - 07 October 1985

GRI: 9950 U.S. Northeast Chain

TDW: 13643.272
TDX: 26973.285
TDY: 45077.793

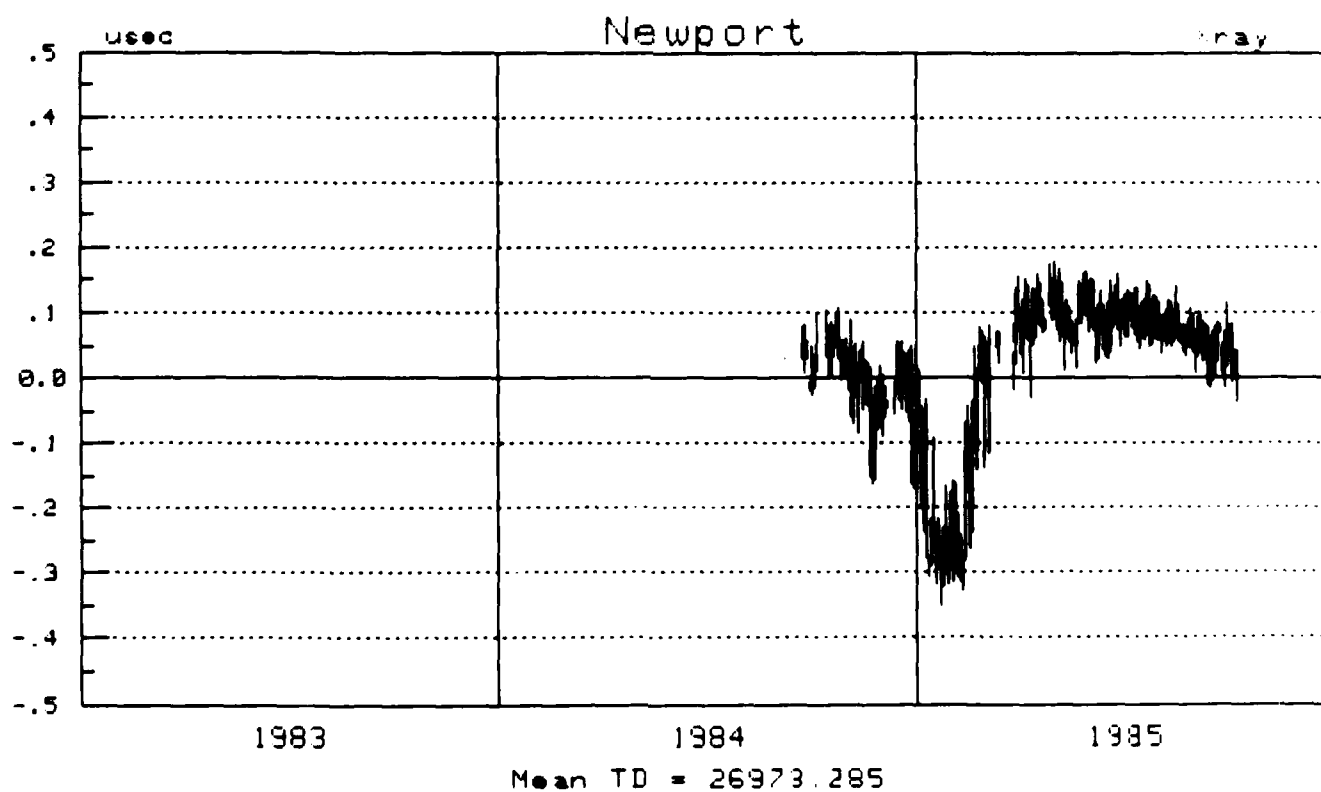
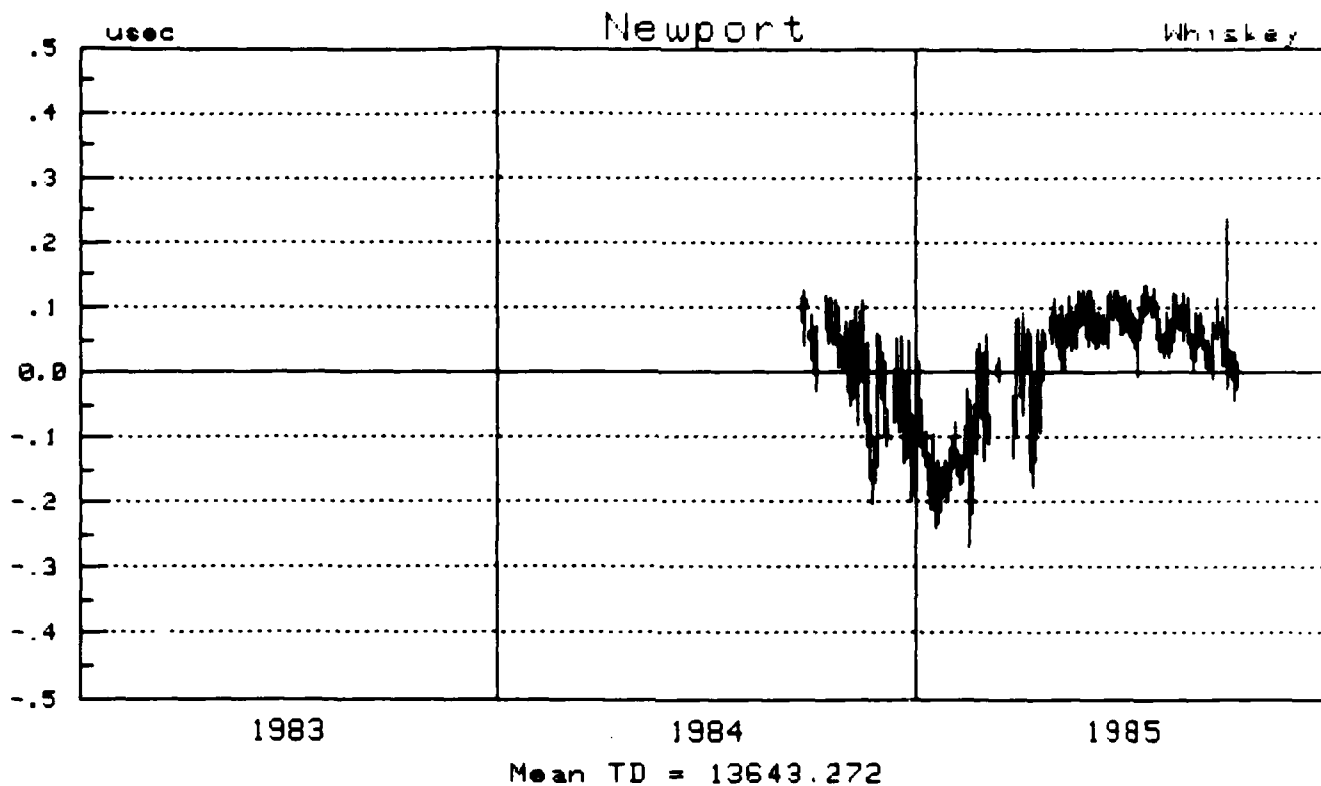
Receiving Antenna Location:

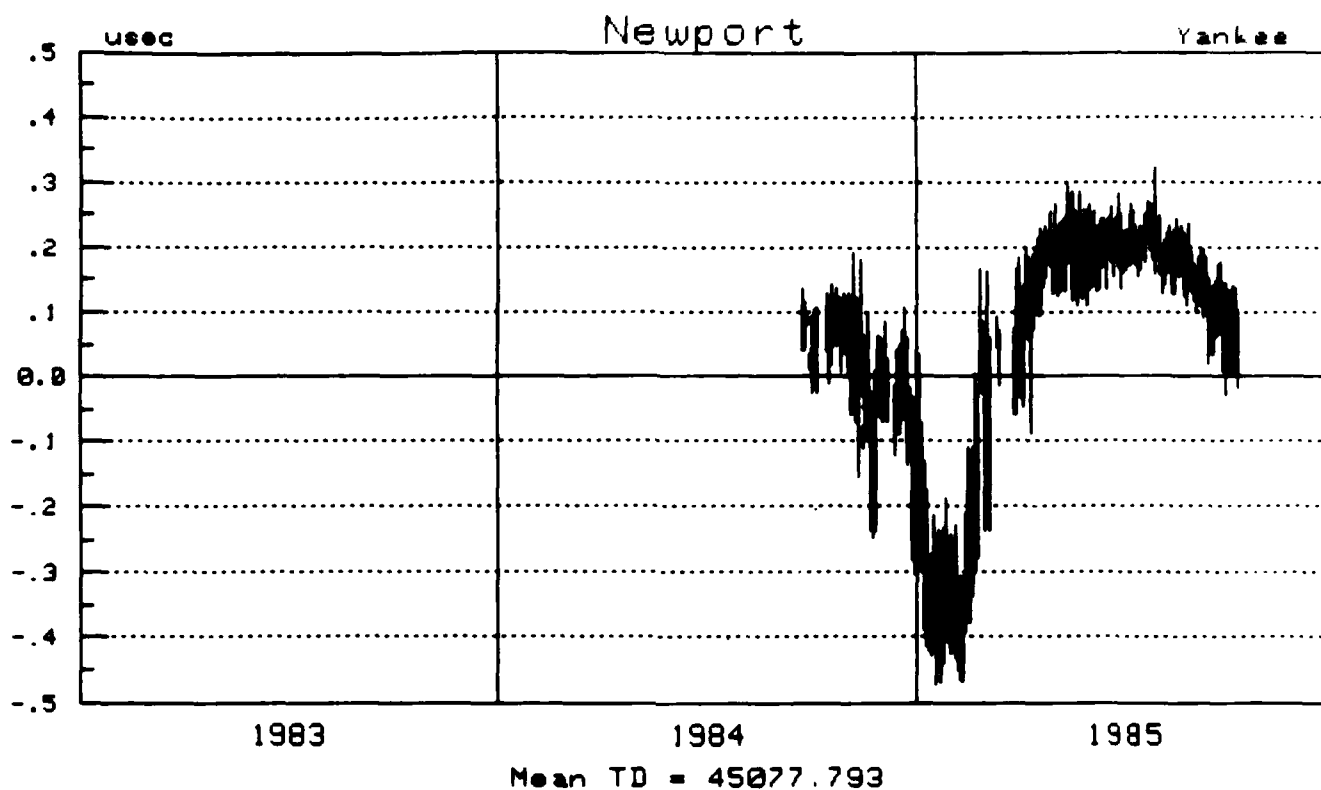
WGS 72
LAT : 44 53 17.79N
LON : 72 13 28.57W

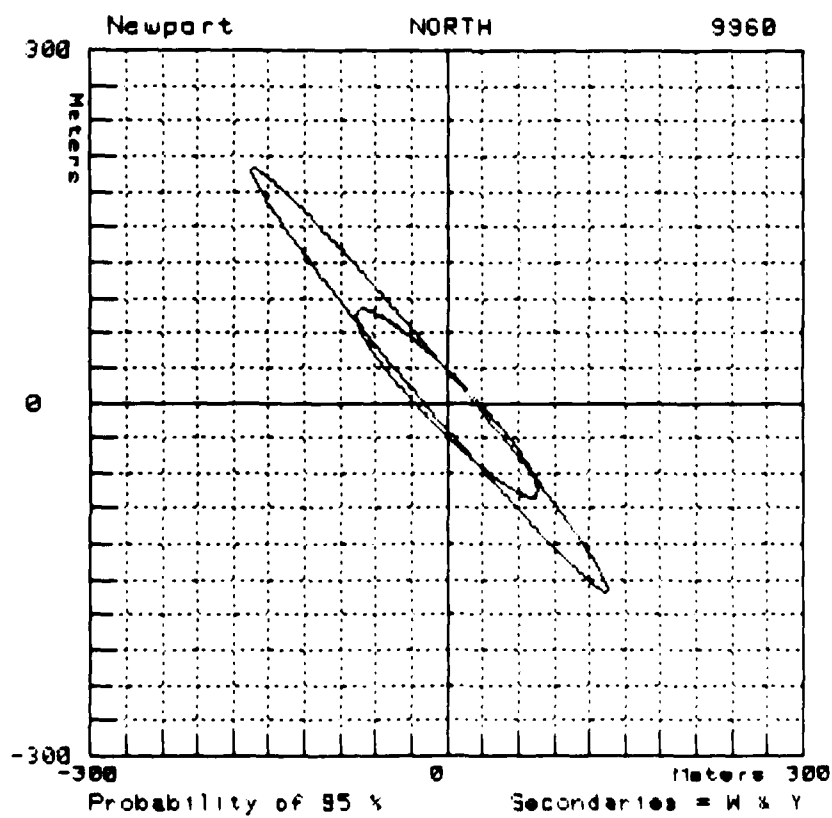
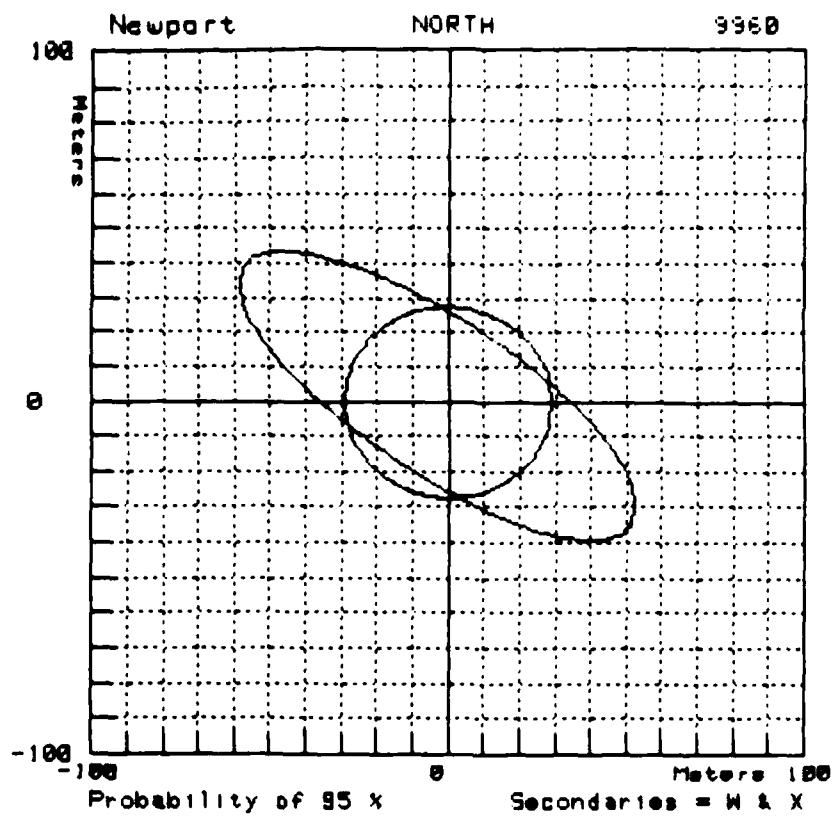
NAD 27
LAT : 44 53 17.89N
LON : 72 13 29.80W

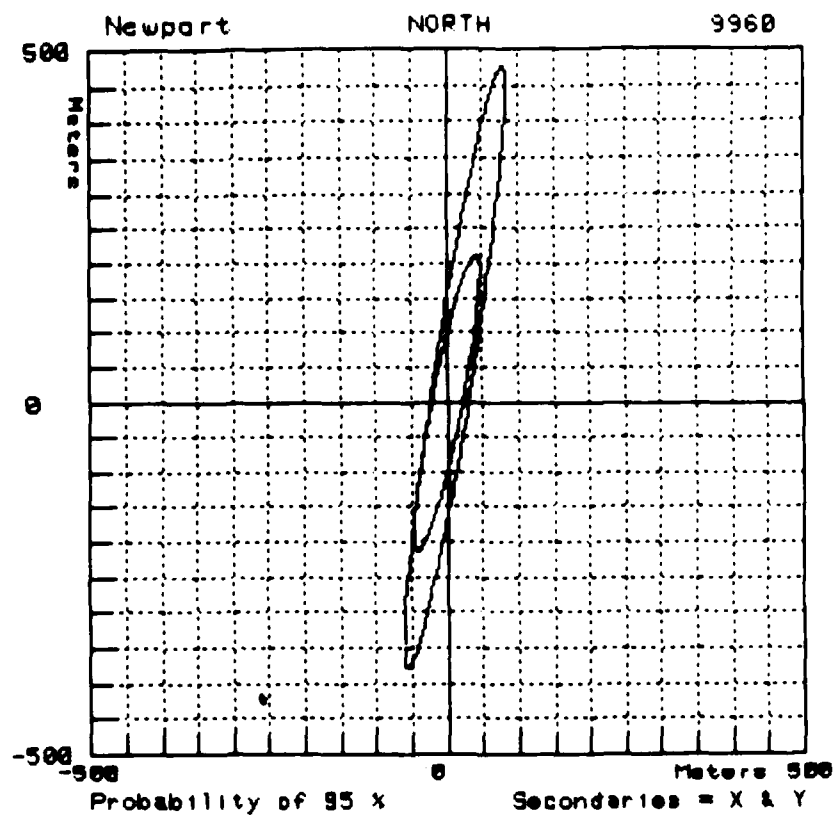
Positioning System
GPS

W-LOP: 147.2 deg	Gradients: 492 ft/usec
X-LOP: 196.6 deg	Gradients: 738 ft/usec
Y-LOP: 221.2 deg	Gradients: 1661 ft/usec









HMS SITE INFORMATION

PITTSFIELD, MASSACHUSETTS

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 13 September 1984 - 06 October 1985

GRI: 9960 U.S. Northeast Chain

TDW: 14982.459
TDX: 27011.559
TDY: 44627.960
TDZ: 60276.067

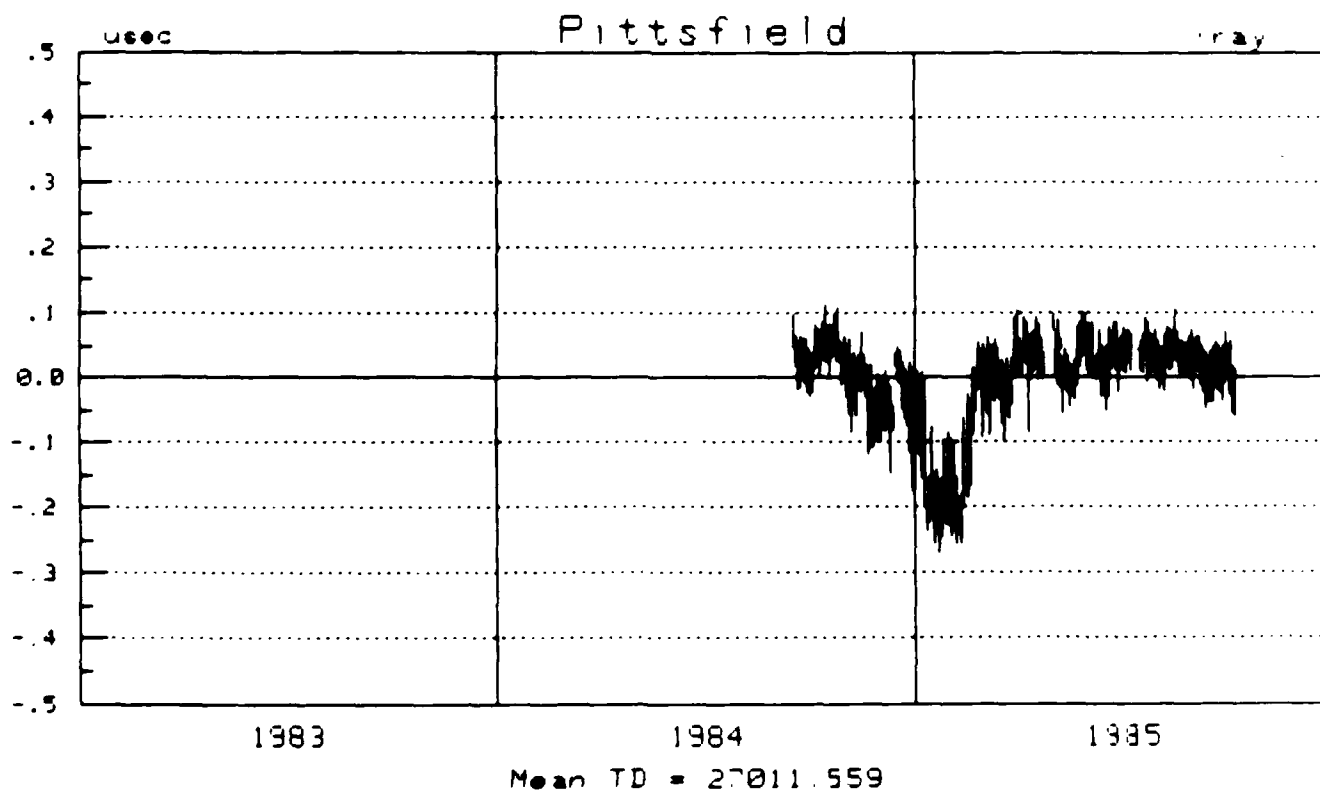
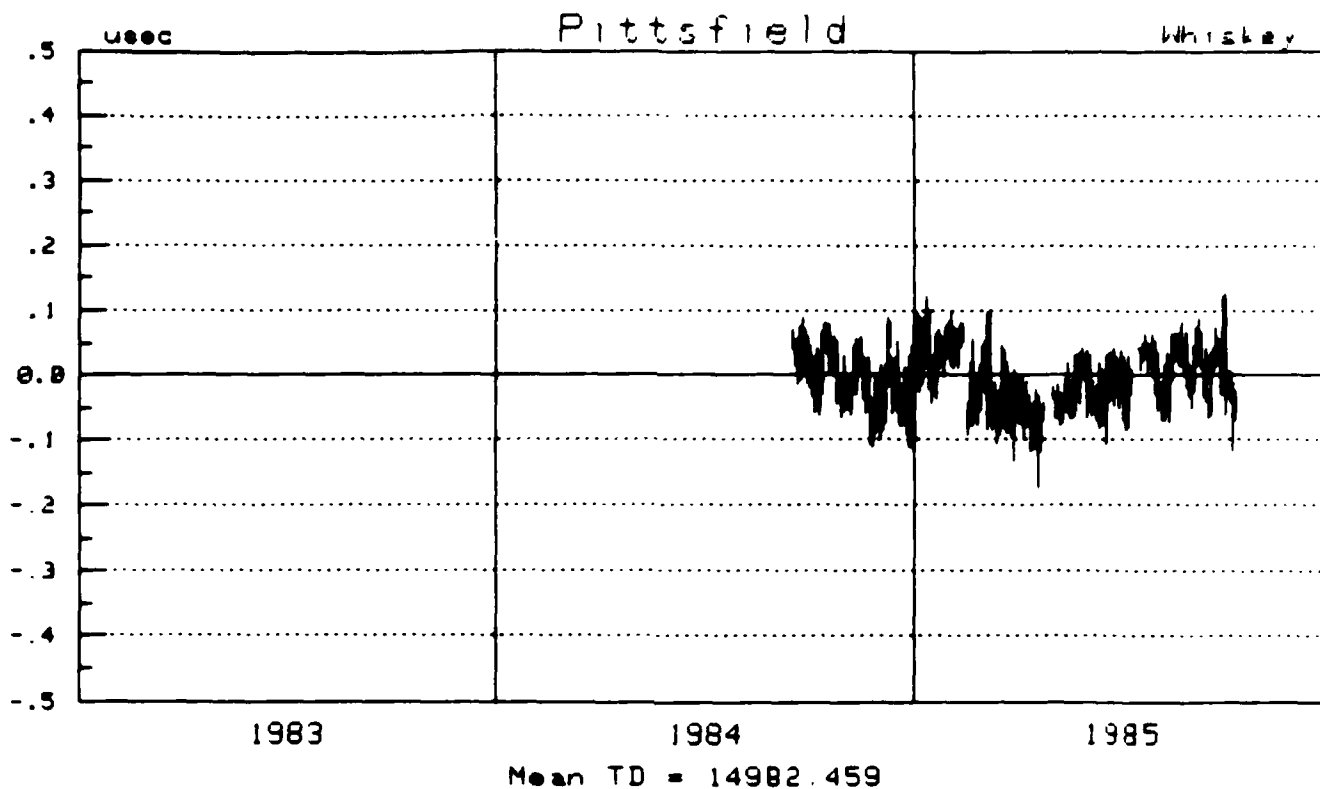
Receiving Antenna Location:

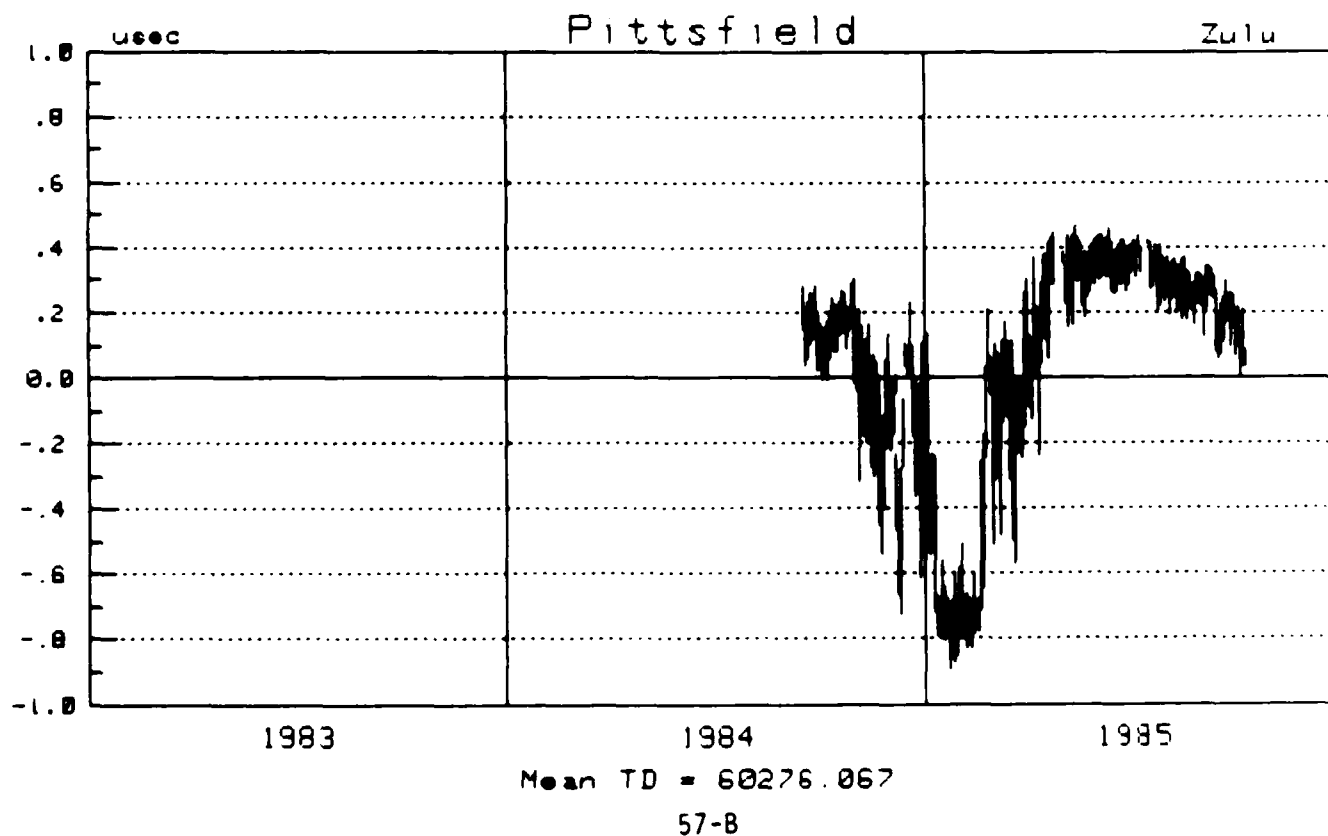
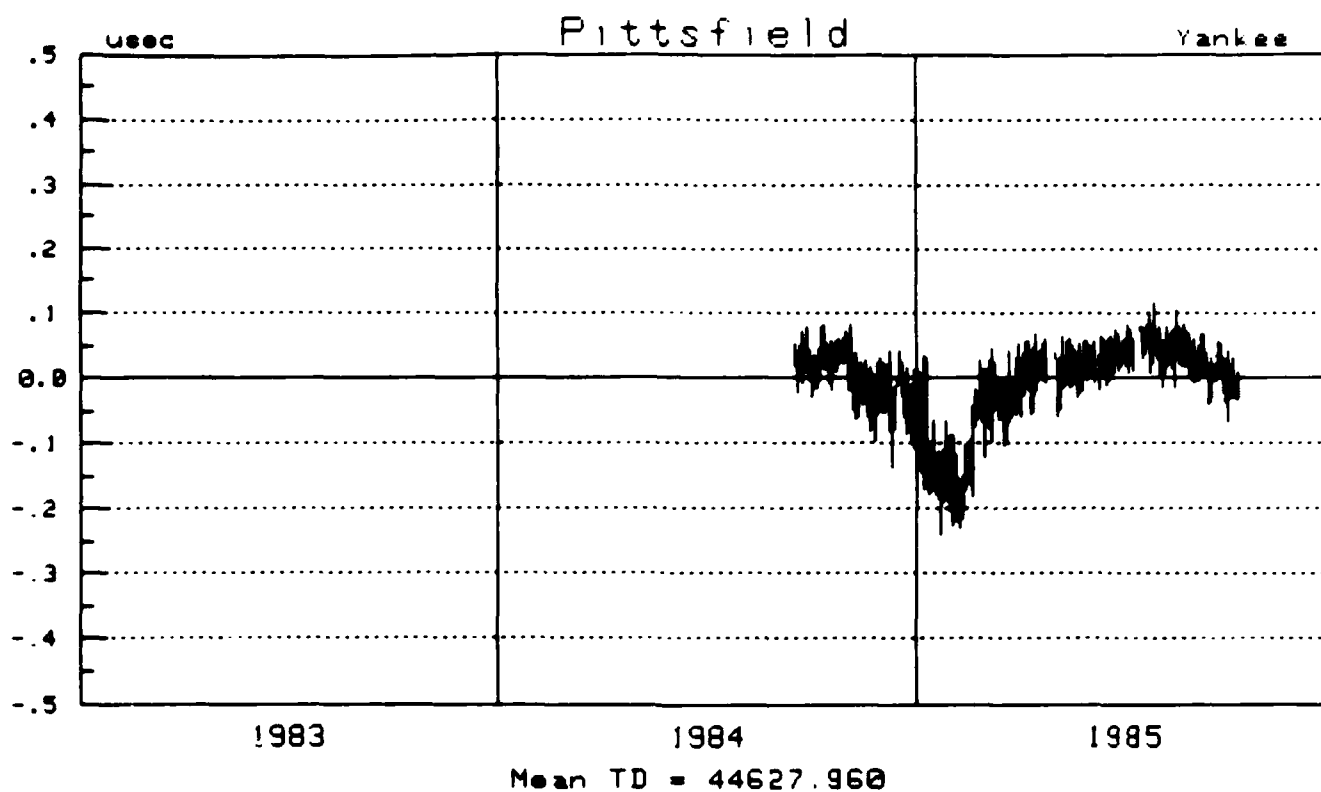
WGS 72
LAT : 42 25 32.3 N
LON : 73 17 30.07W

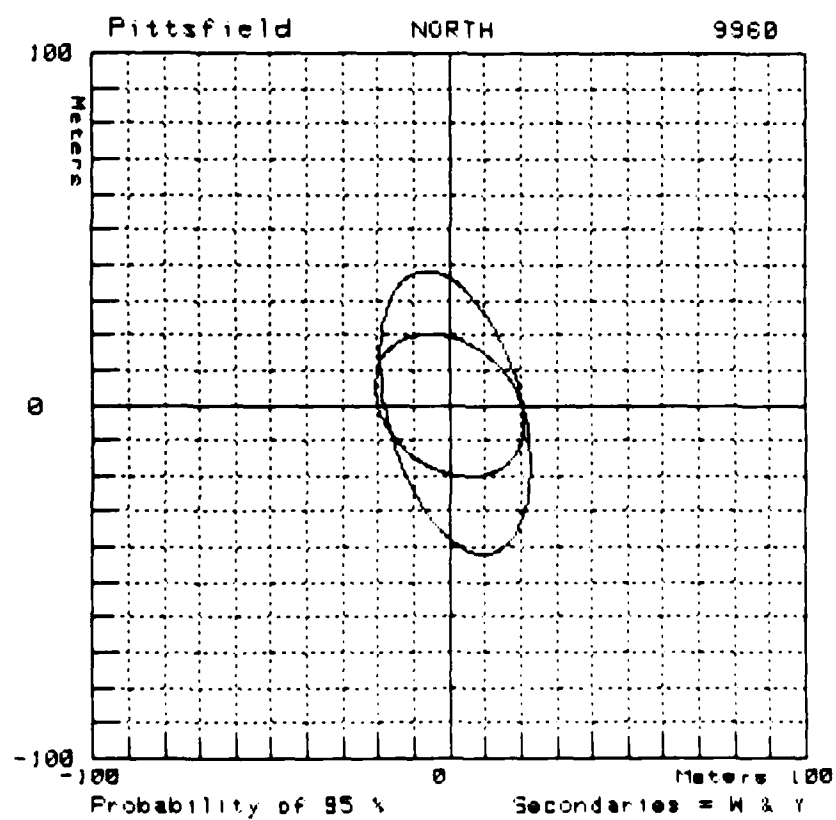
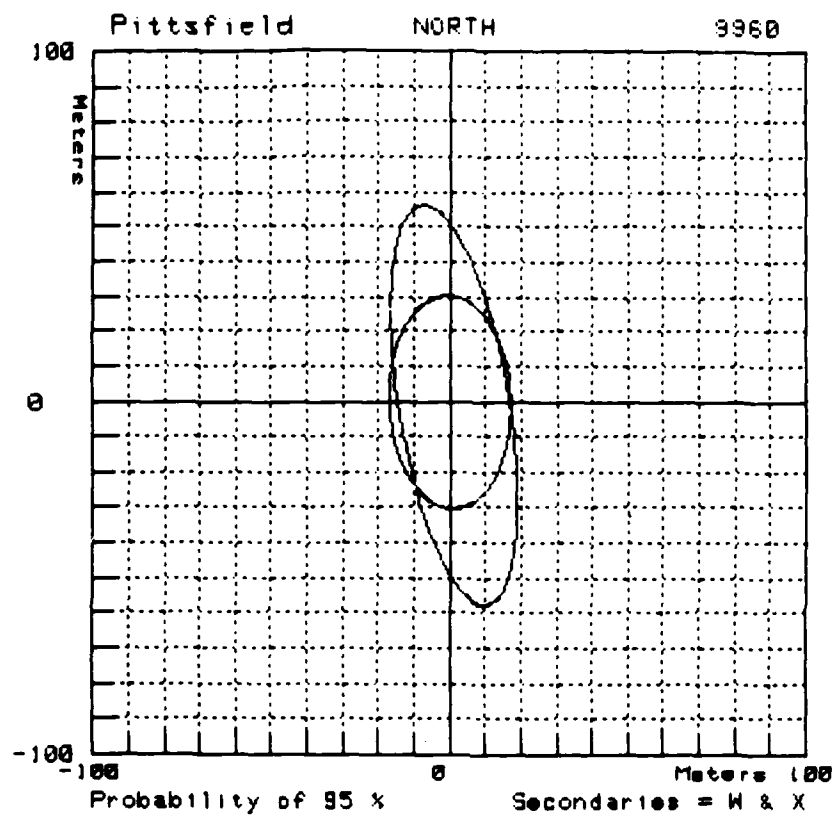
NAD 27
LAT : 42 25 32.34N
LON : 73 17 31.12W

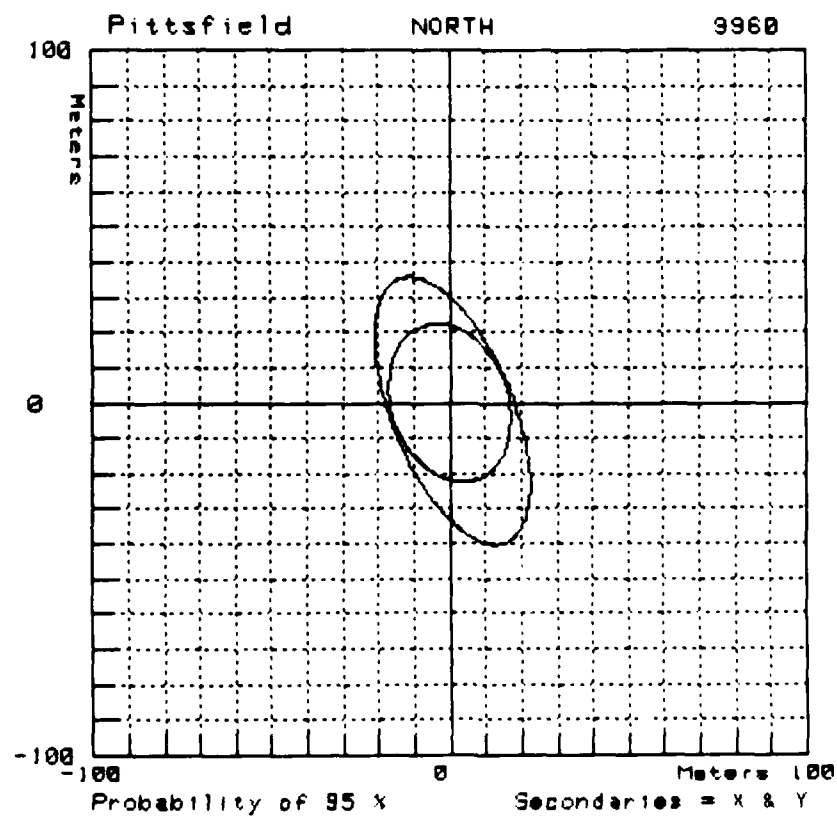
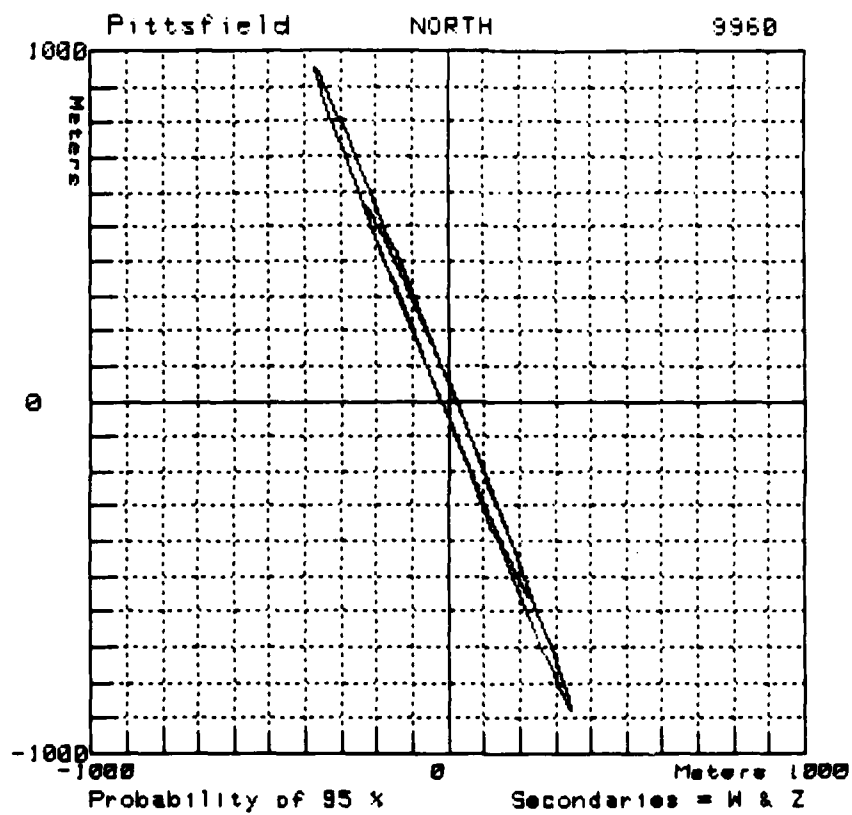
Positioning System
GPS

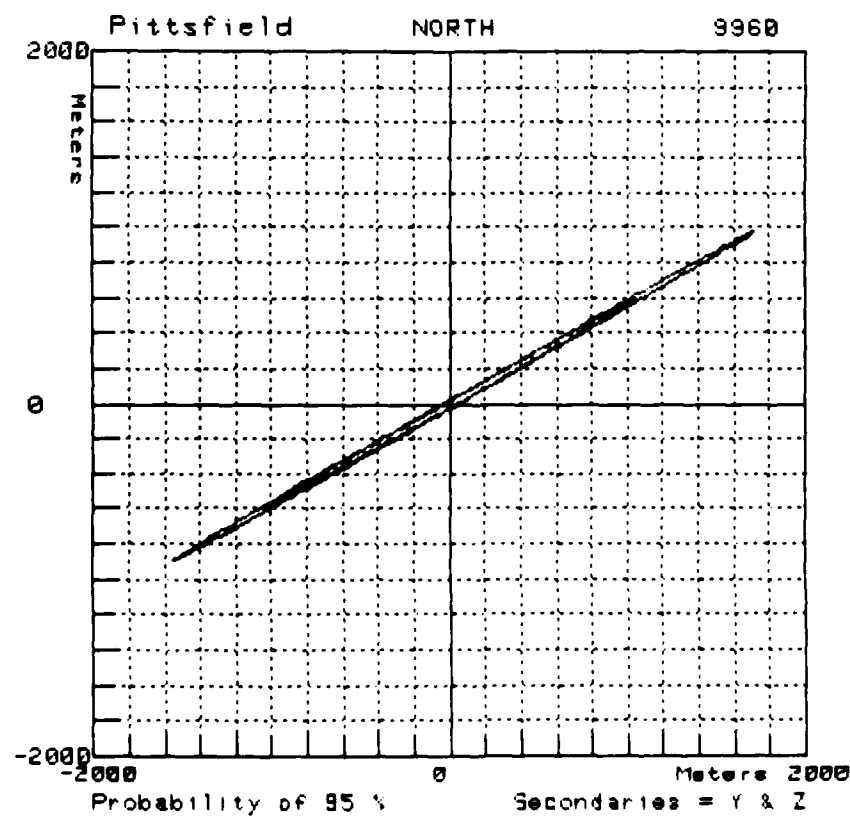
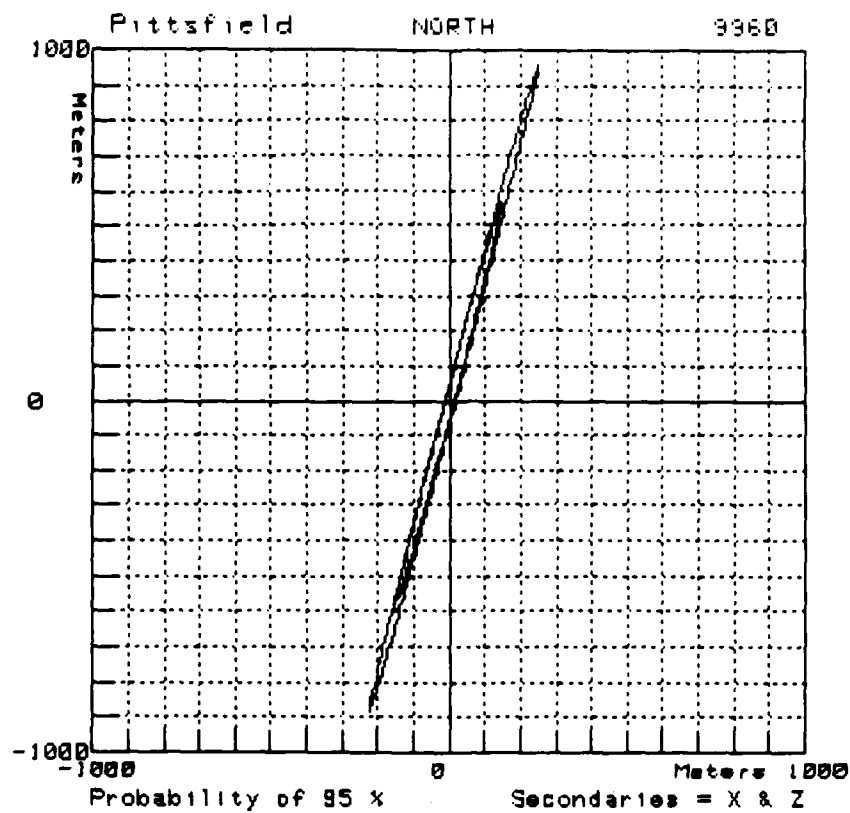
W-LOP: 158.4 deg	Gradients: 563 ft/usec
X-LOP: 195.8 deg	Gradients: 497 ft/usec
Y-LOP: 241.2 deg	Gradients: 831 ft/usec
Z-LOP: 269.3 deg	Gradients: 3486 ft/usec











HMS SITE INFORMATION

PLUMBROOK, OHIO

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 01 September 1980 - 15 May 1984 &
02 October 1984 - Present

GRI: 9960 U.S. Northeast Chain

TDZ: 56950.888 A1 Control

Receiving Antenna Location:

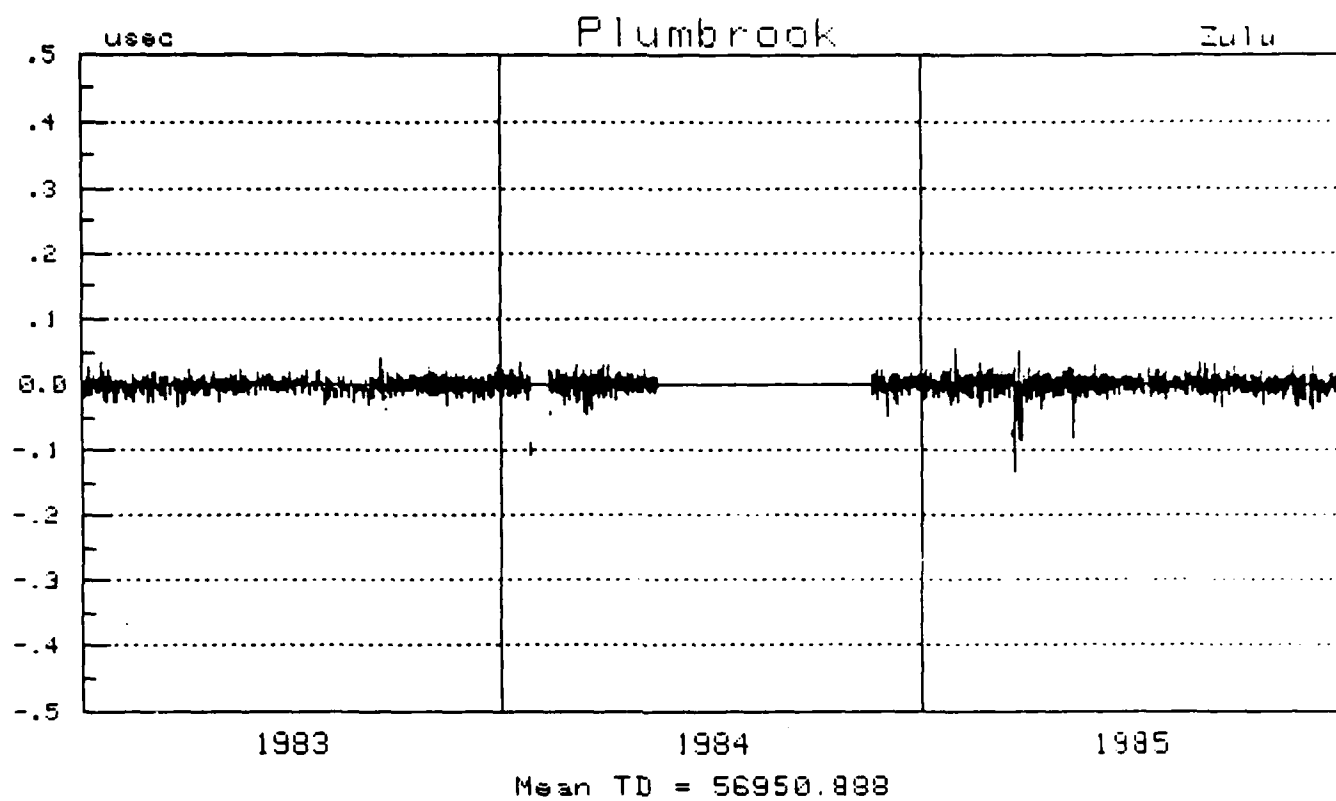
WGS 72
LAT : 41 22 46.96N
LON : 82 39 38.53W

NAD 27
LAT : 41 22 46.94N
LON : 82 39 38.45W

Positioning System
From G-NRN

Z-LOP: 160.0 deg

Gradients: 492 ft/usec



HMS SITE INFORMATION

RUTLAND, VERMONT

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 31 August 1984 - Present

GRI: 9960 U.S. Northeast Chain

TDW: 14494.354
TDX: 27047.015
TDY: 44917.596
TDZ: 60325.955

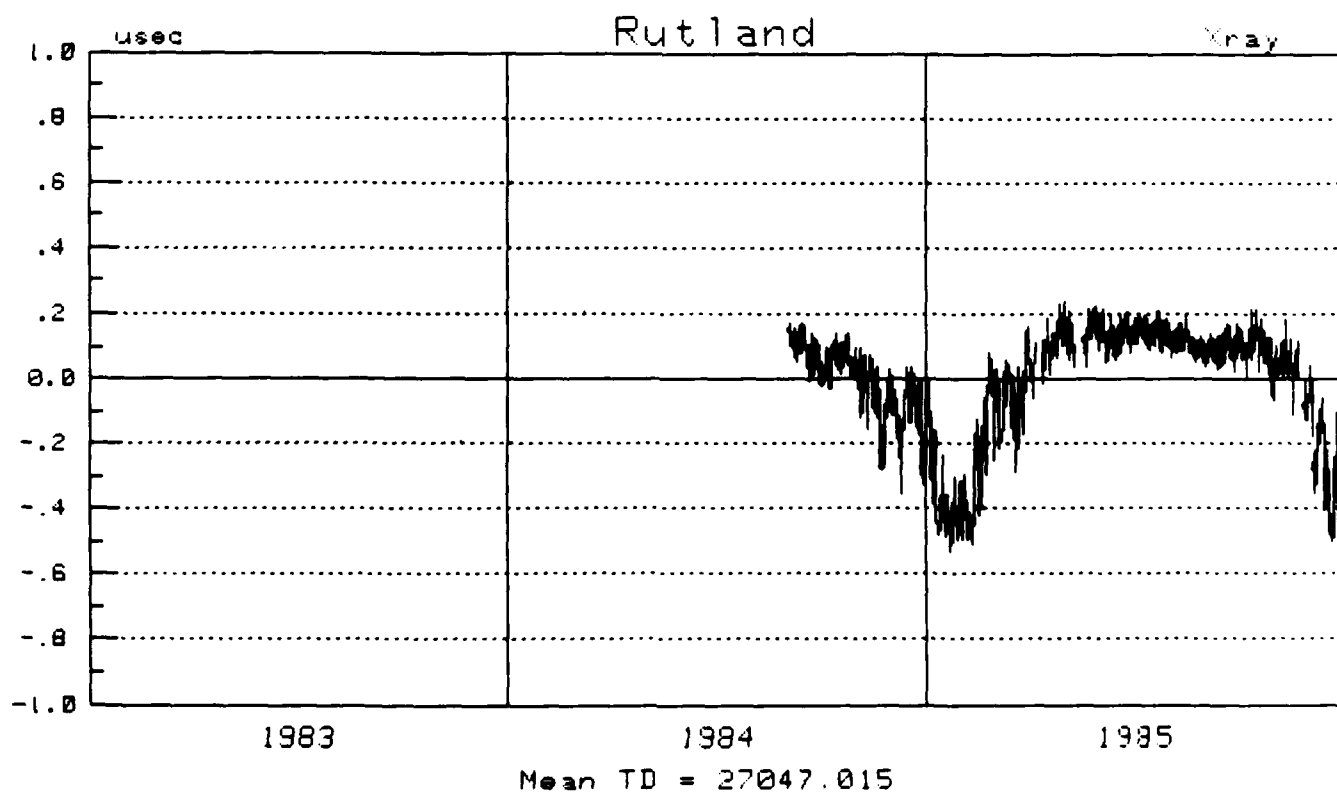
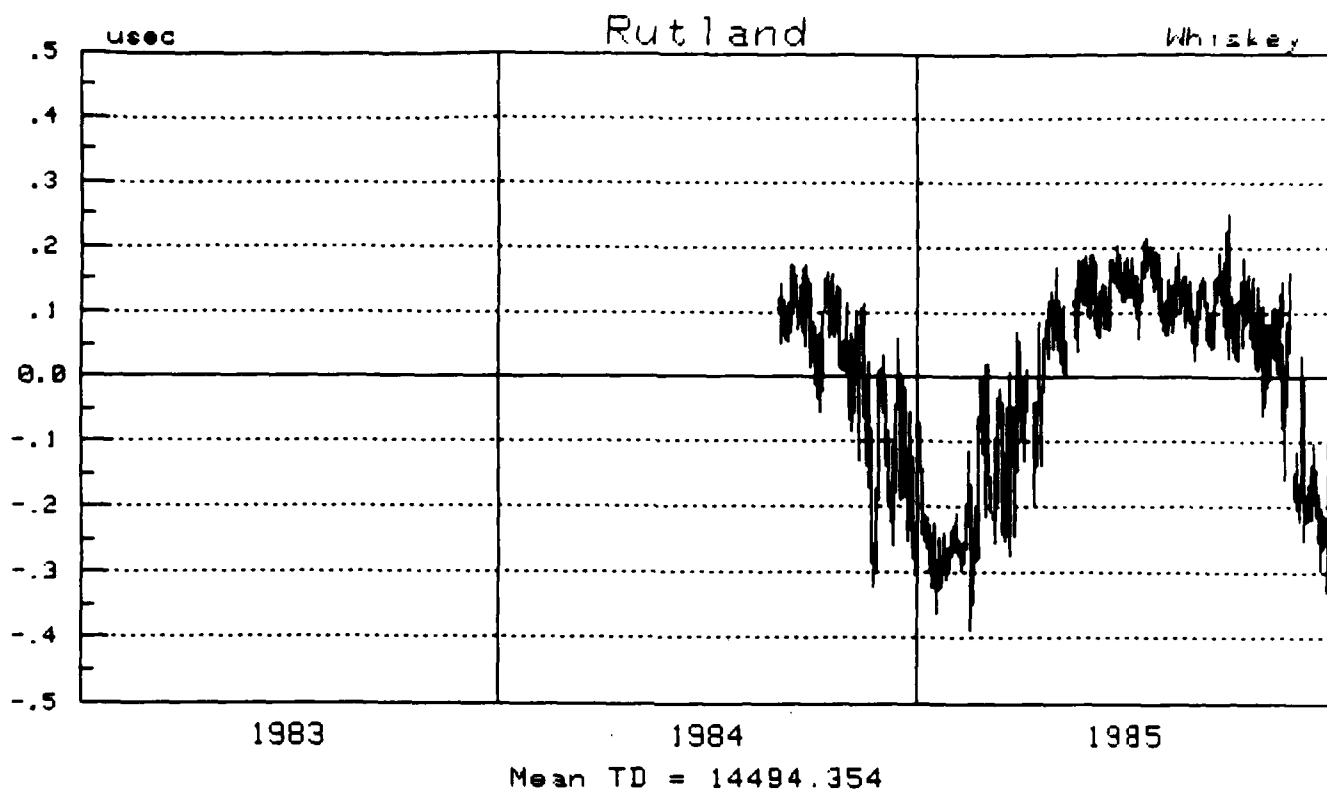
Receiving Antenna Location:

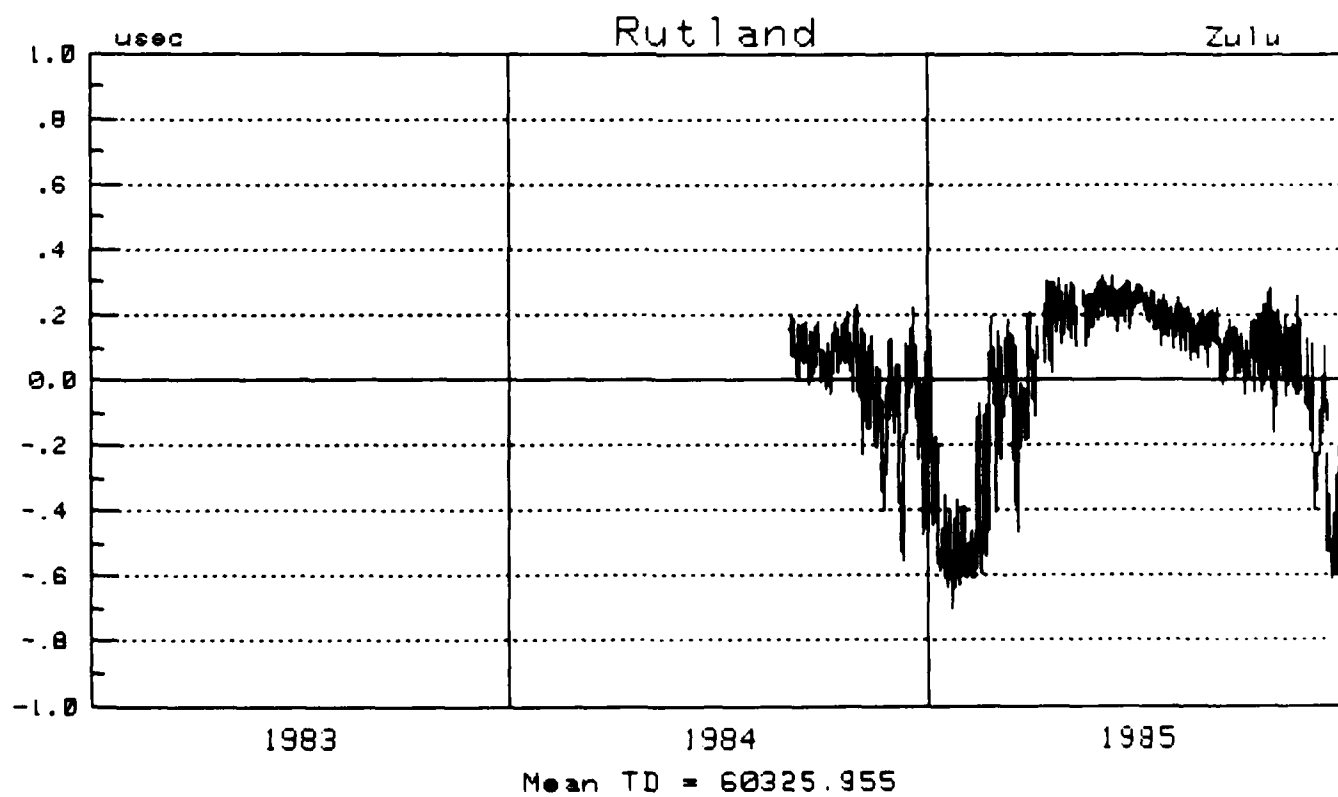
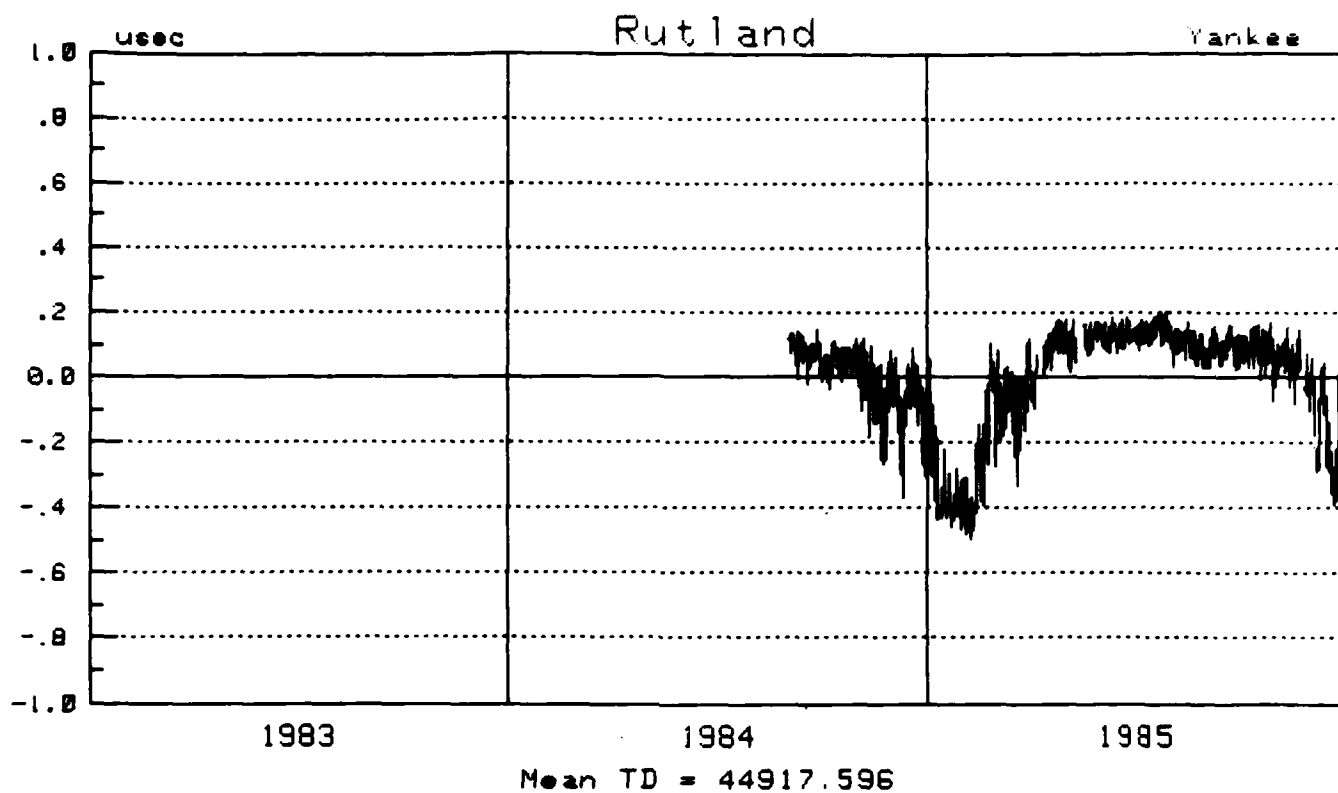
WGS 72
LAT : 43 31 40.36N
LON: 72 56 45.03W

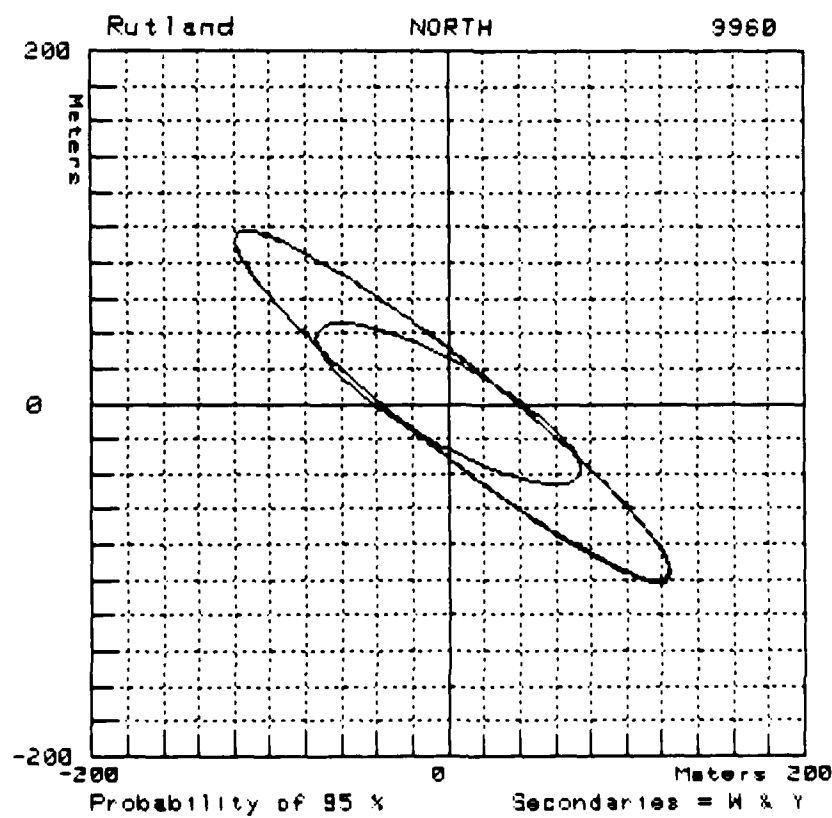
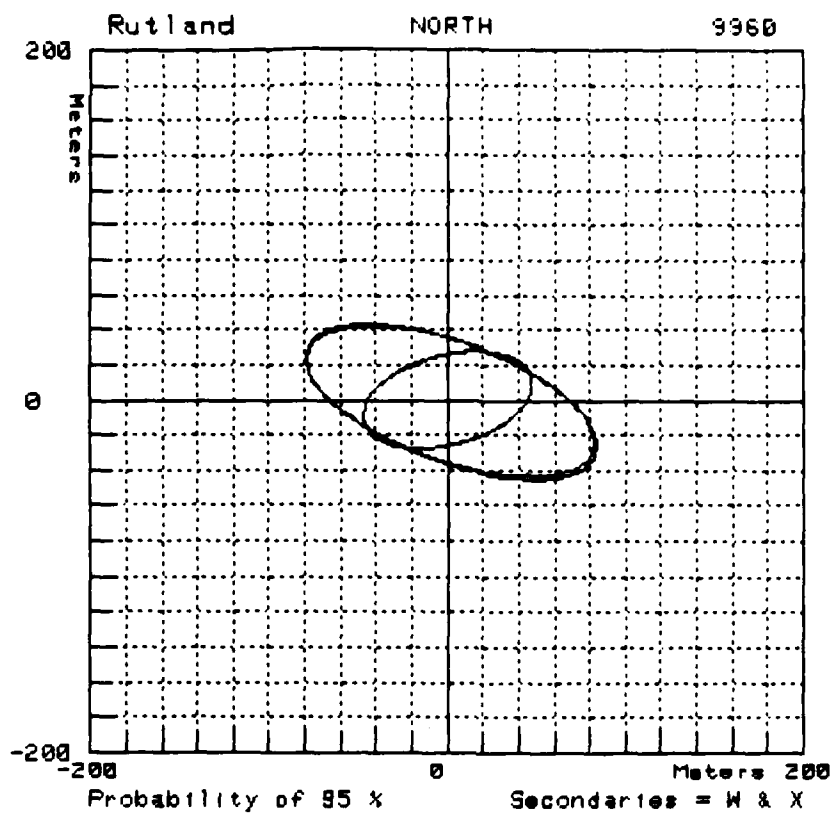
NAD 27
LAT : 43 31 40.44N
LON : 72 56 46.14W

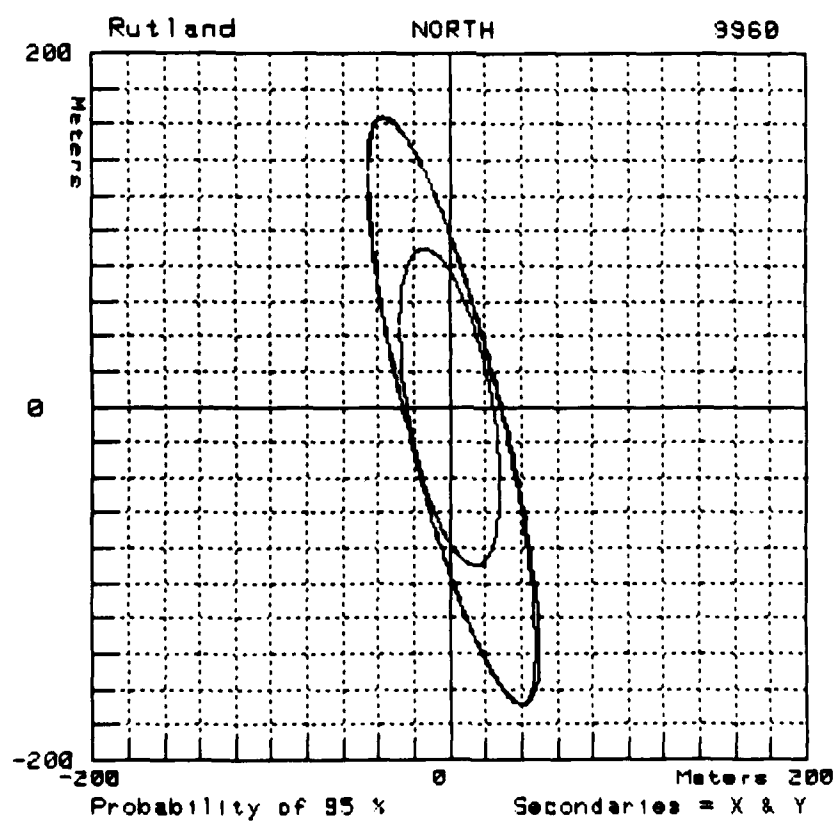
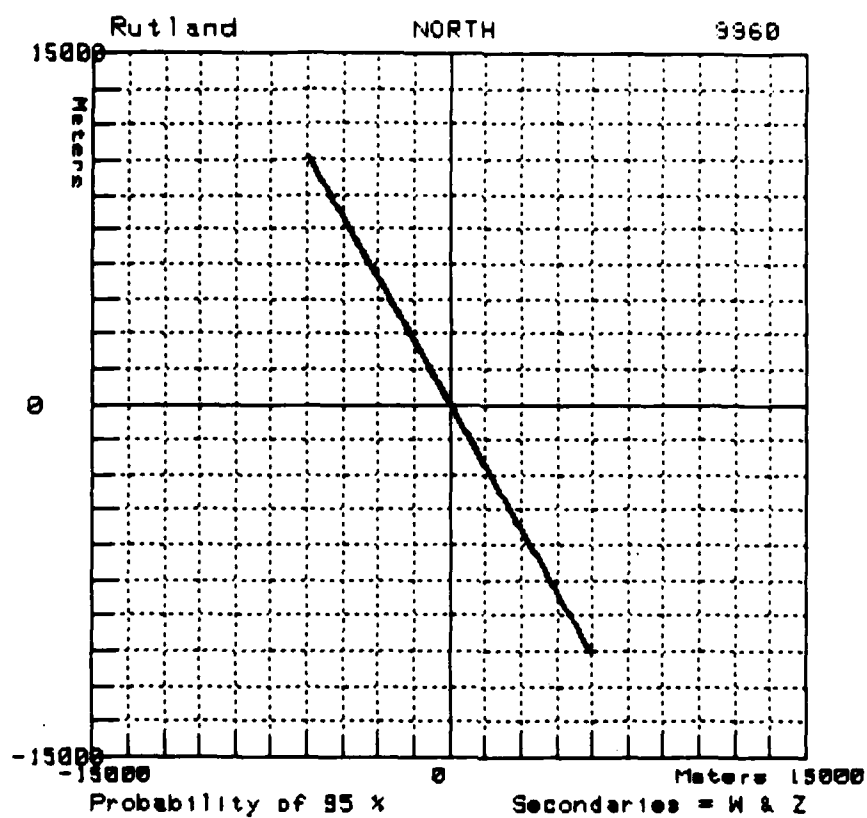
Positioning System
GPS

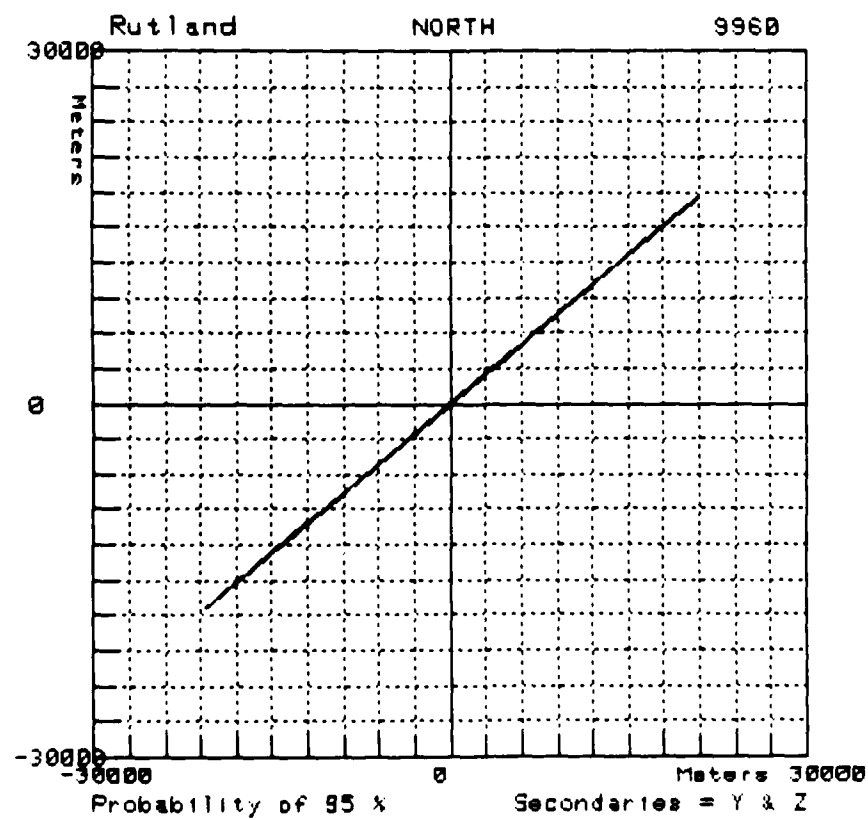
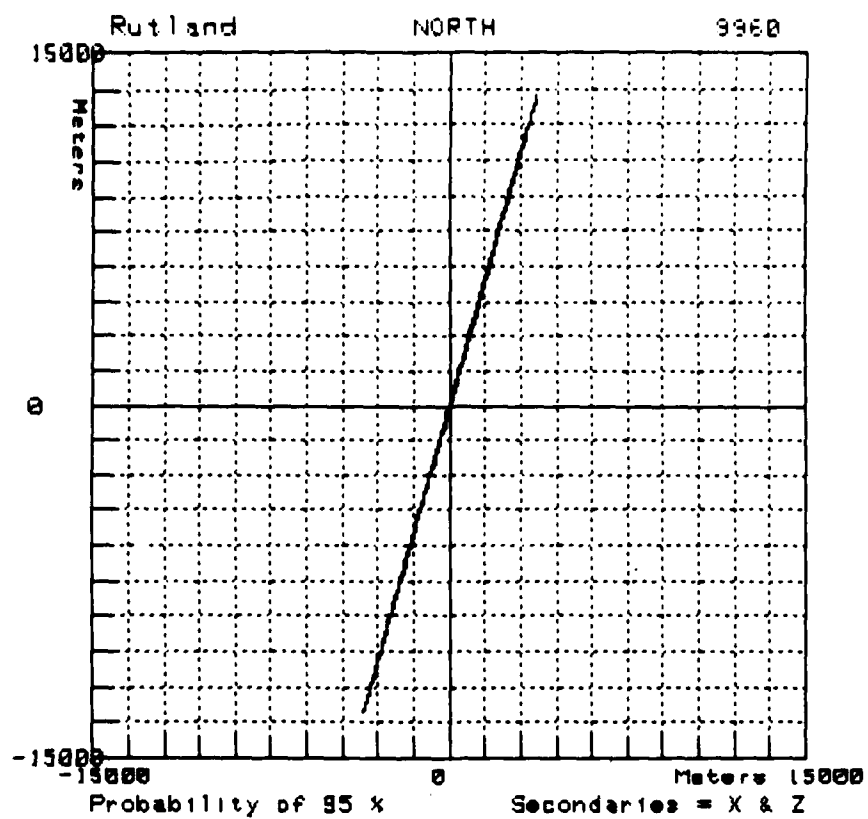
W-LOP: 150.4 deg	Gradients: 509 ft/usec
X-LOP: 195.1 deg	Gradients: 566 ft/usec
Y-LOP: 229.6 deg	Gradients: 1134 ft/usec
Z-LOP: 255.8 deg	Gradients: 57158 ft/usec











HMS SITE INFORMATION

SANDY HOOK, NEW JERSEY

Monitor: Type-A
Monitor Equipment: Austron 5000 System
Data Collection: 01 September 1980 - Present

GRI: 9960 U.S. Northeast Chain

TDW: 15521.823 A2
TDX: 26999.779 A1 Control
TDY: 43720.369 A1 Control

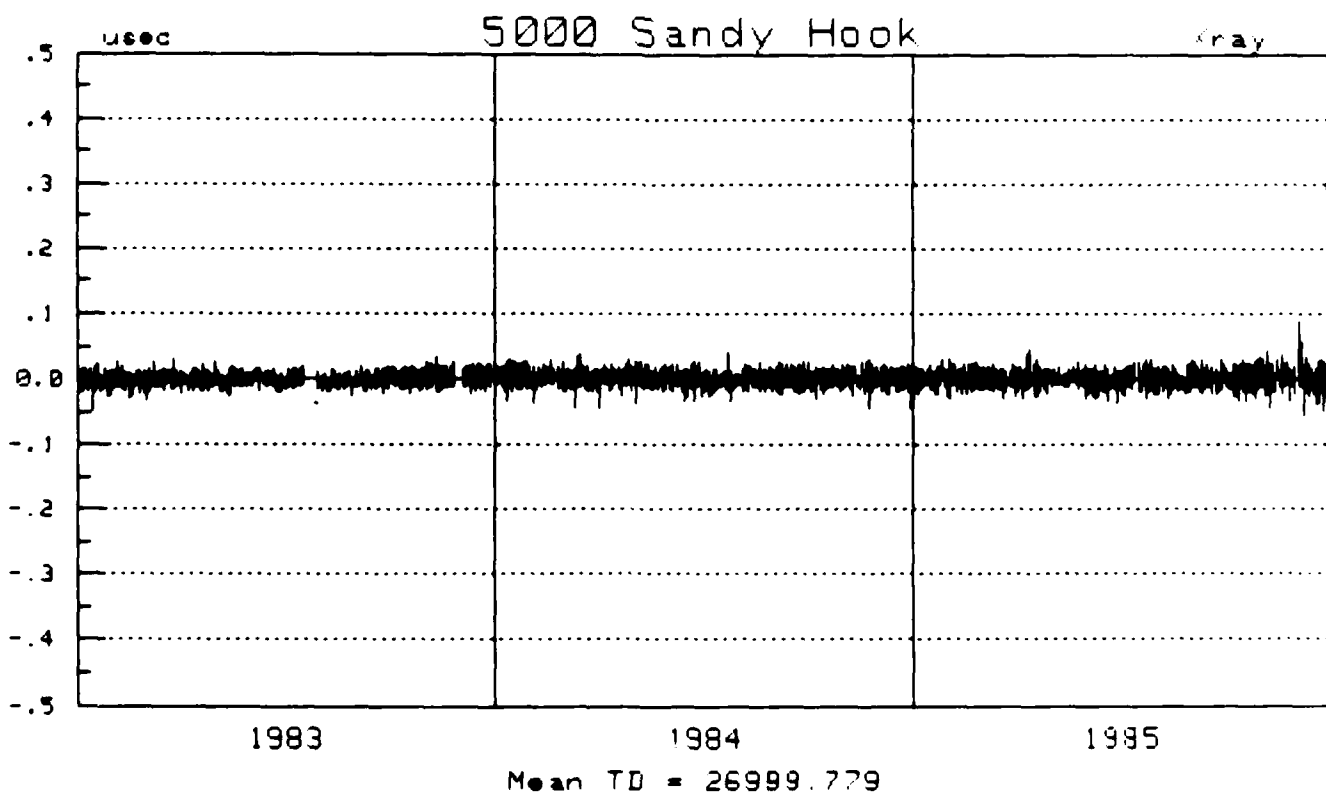
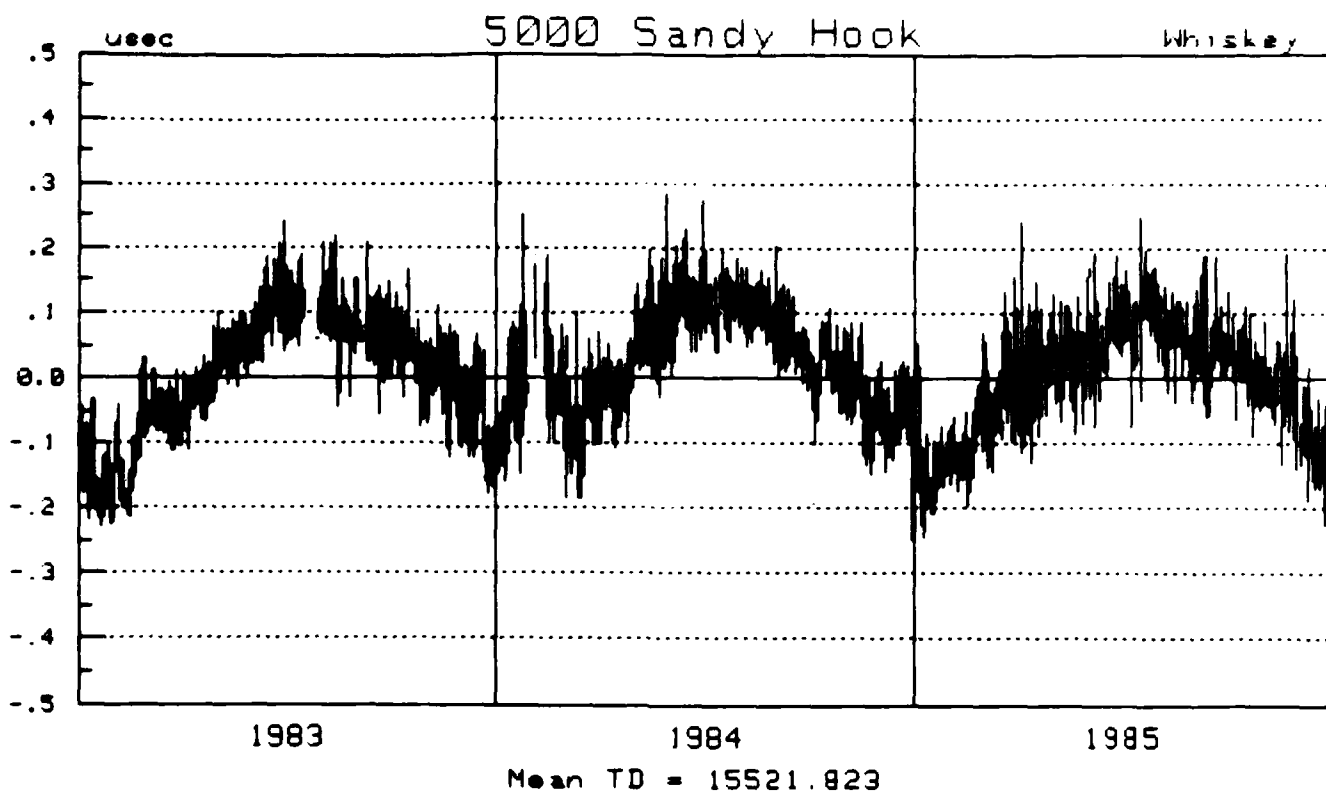
Receiving Antenna Location:

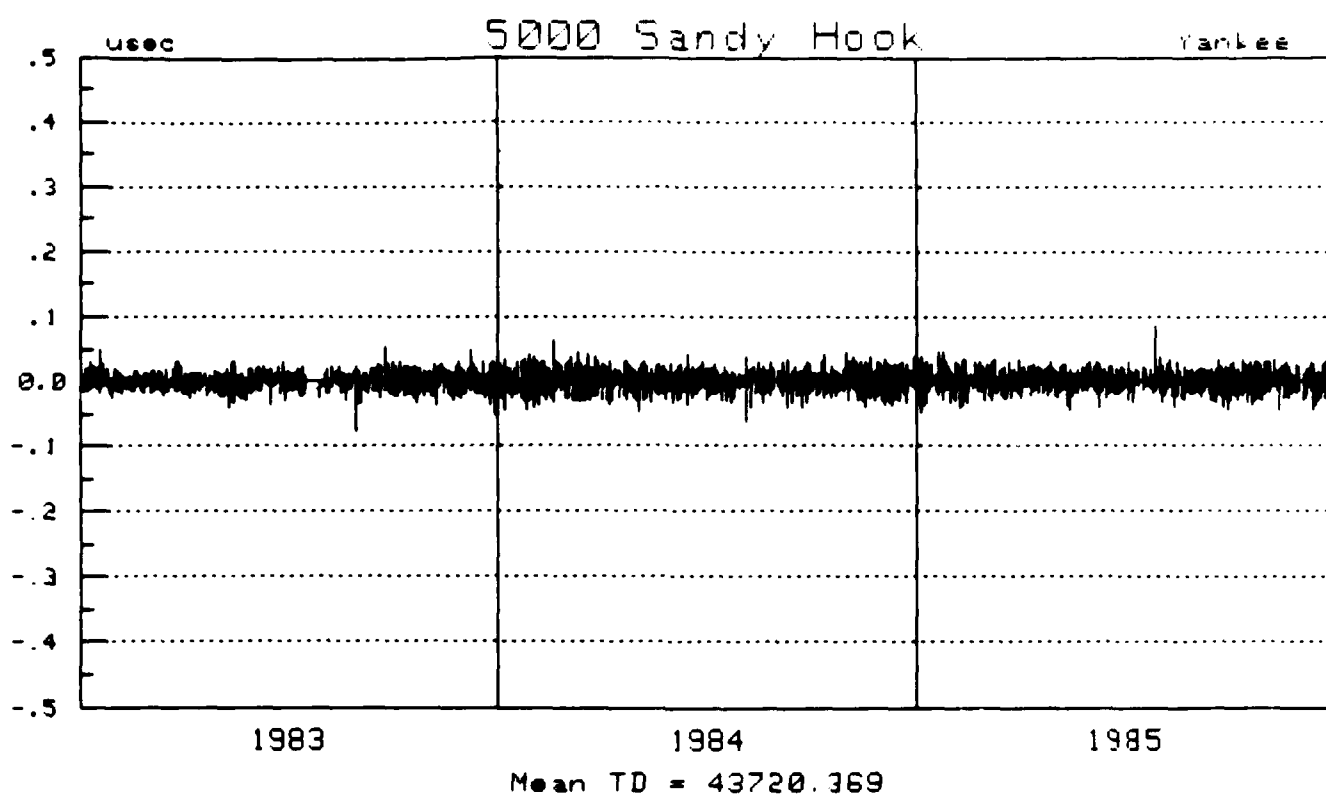
WGS 72
LAT : 40 28 17.04N
LON : 74 01 03.71W

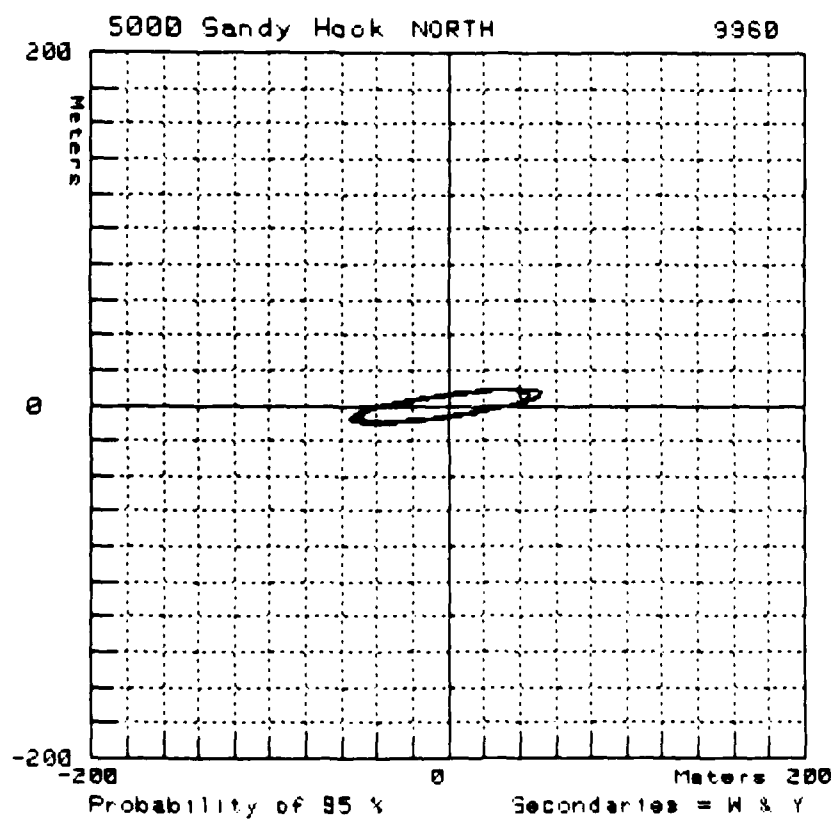
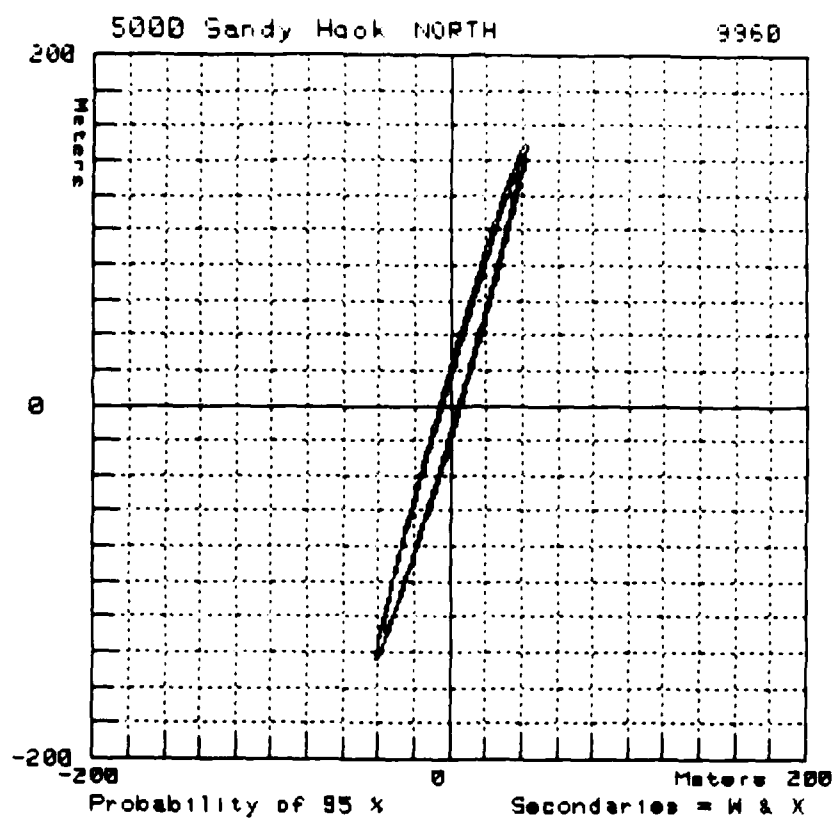
NAD 27
LAT : 40 28 17.02N
LON : 74 01 4.65W

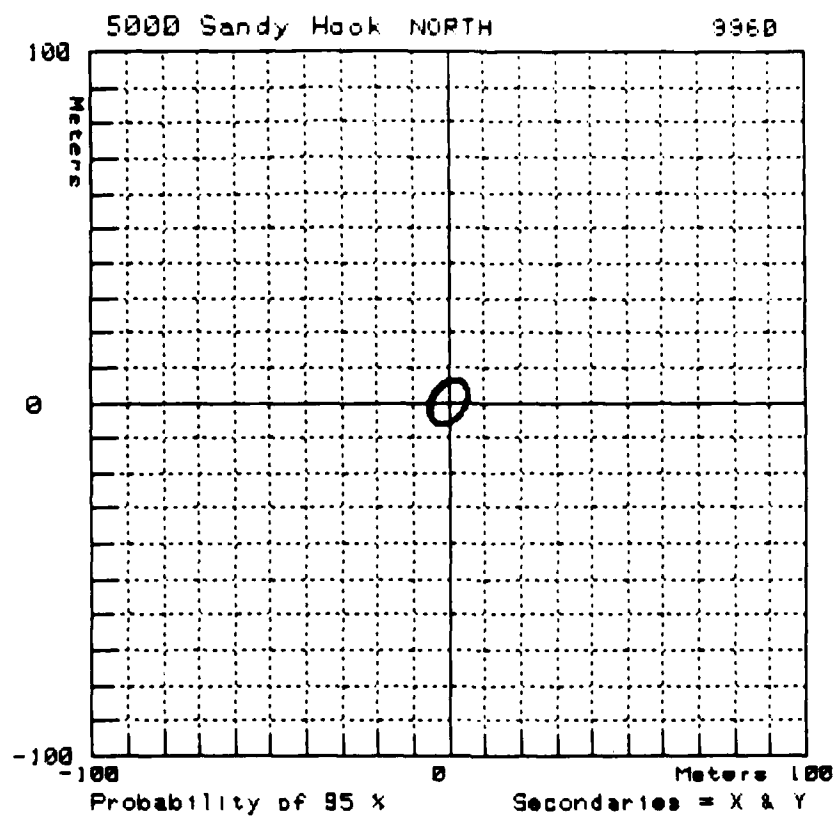
Positioning System
From G-NRN

W-LOP: 175.3 deg Gradients: 806 ft/usec
X-LOP: 196.1 deg Gradients: 578 ft/usec
Y-LOP: 262.4 deg Gradients: 598 ft/usec









HMS SITE INFORMATION

SANDY HOOK, NEW JERSEY

Monitor: Type-D
Monitor Equipment: LC-404 & HP-9915
Data Collection: April 1983 - December 1984

GRI: 9960 U.S. Northeast Chain

TDW: 15521.818
TDX: 26999.699
TDY: 43720.497

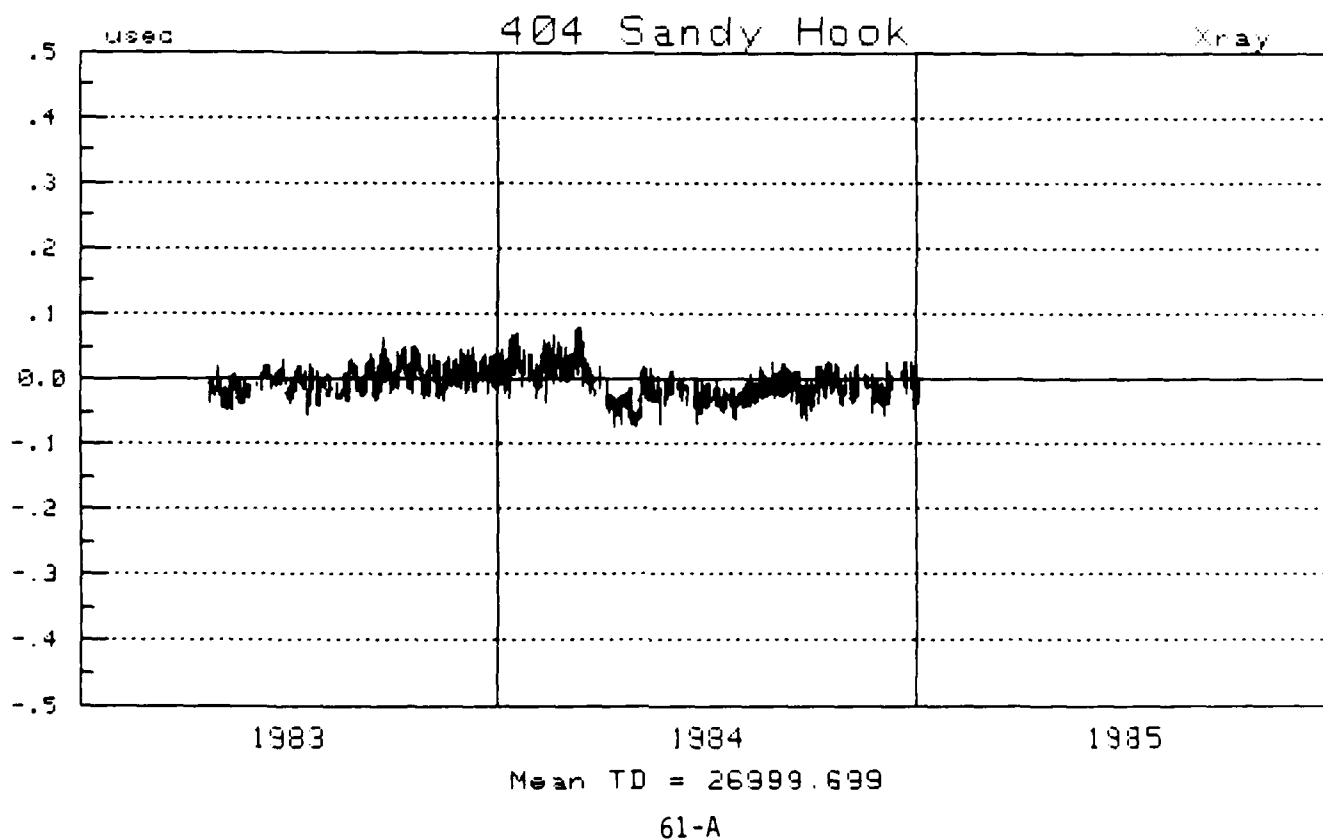
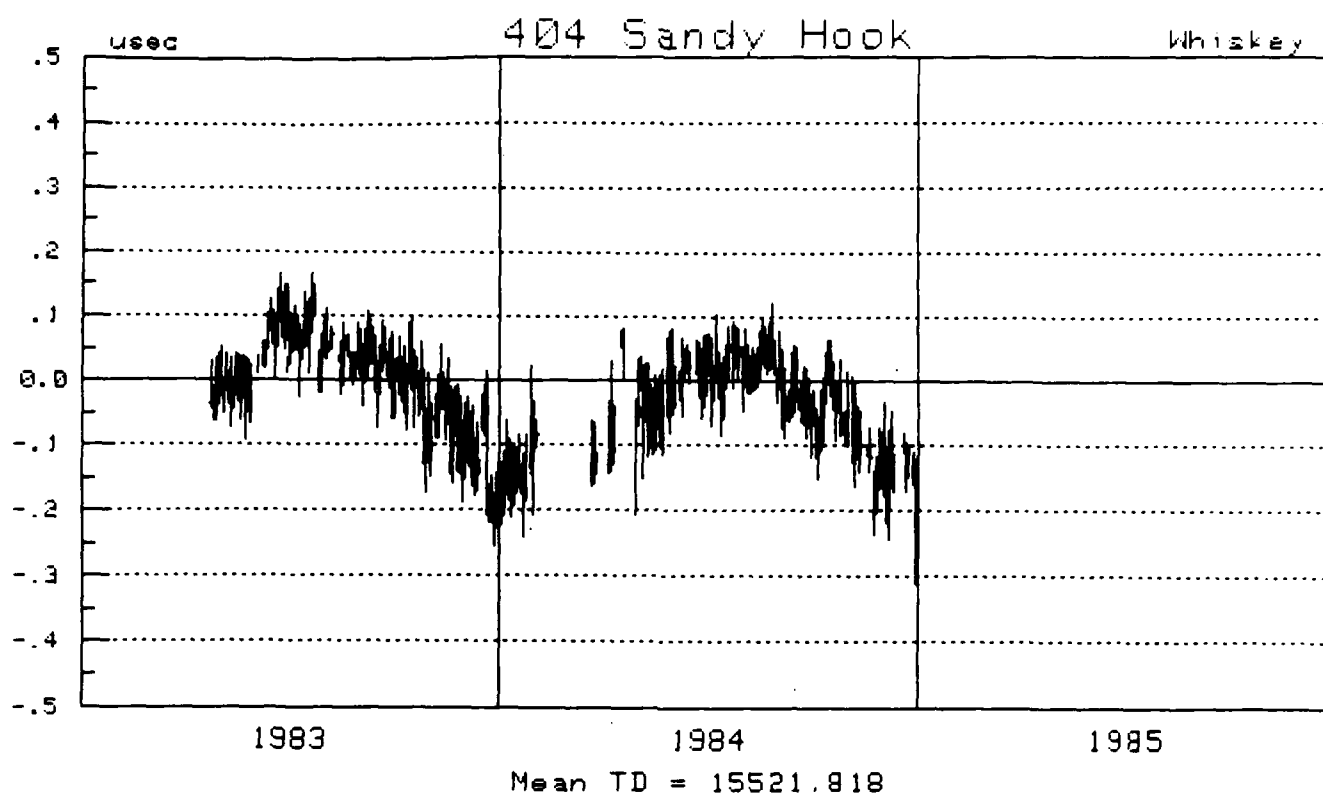
Receiving Antenna Location:

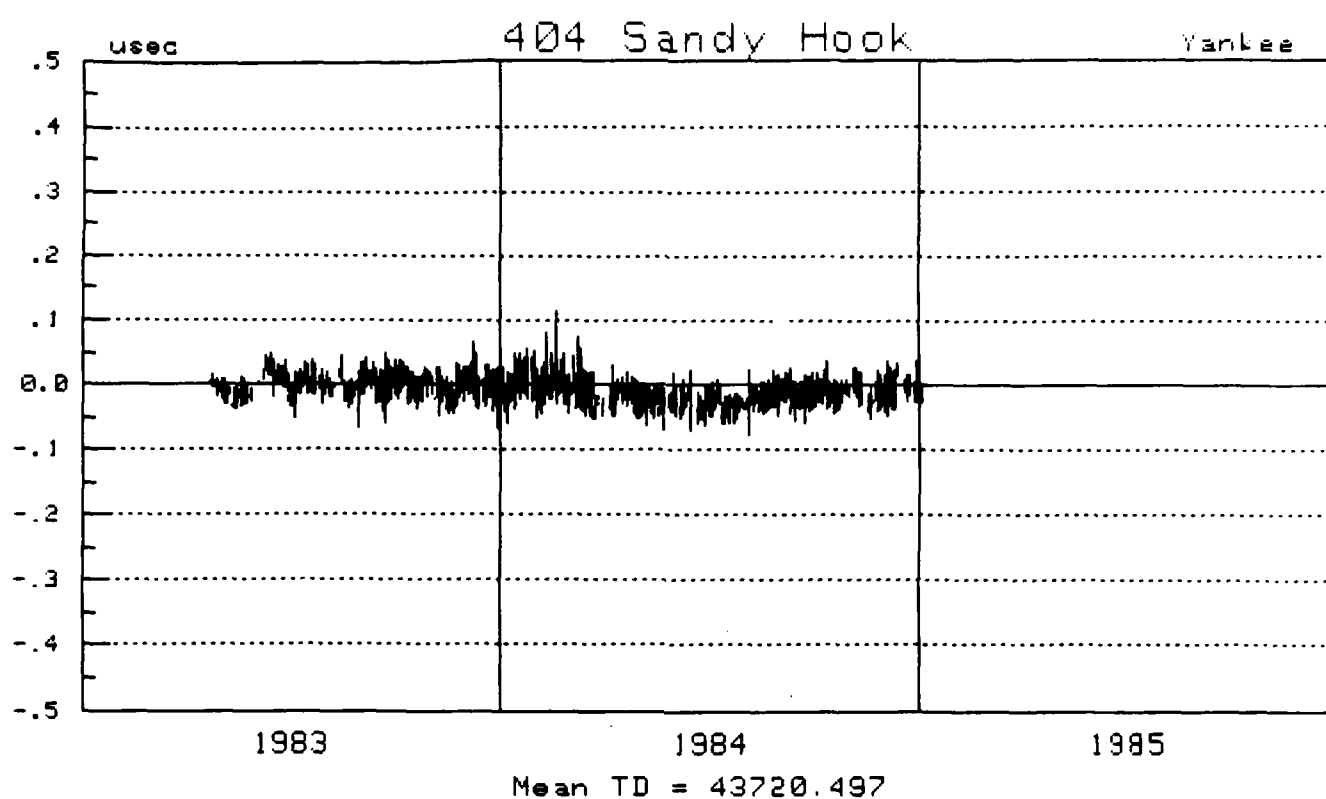
WGS 72
LAT : 40 28 17.04N
LON : 74 01 03.71W

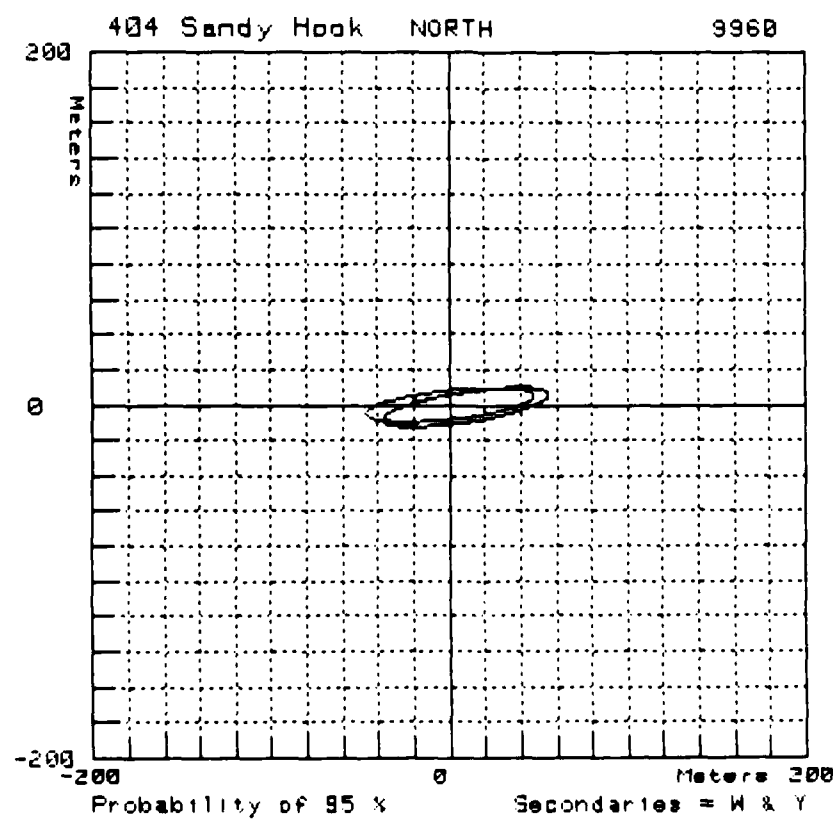
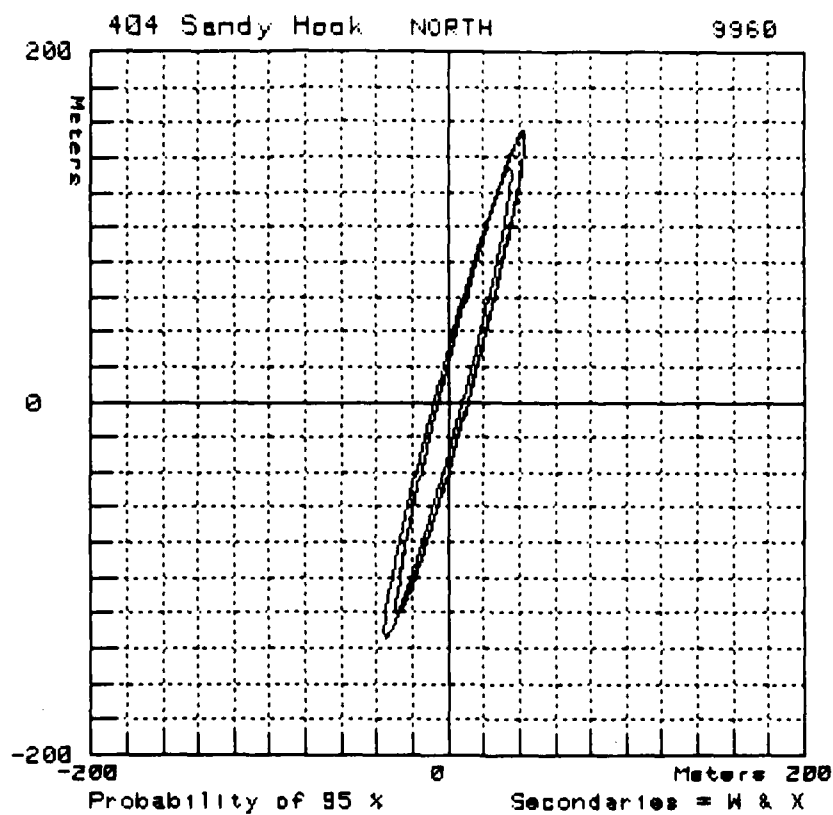
NAD 27
LAT : 40 28 17.02N
LON : 74 01 04.65W

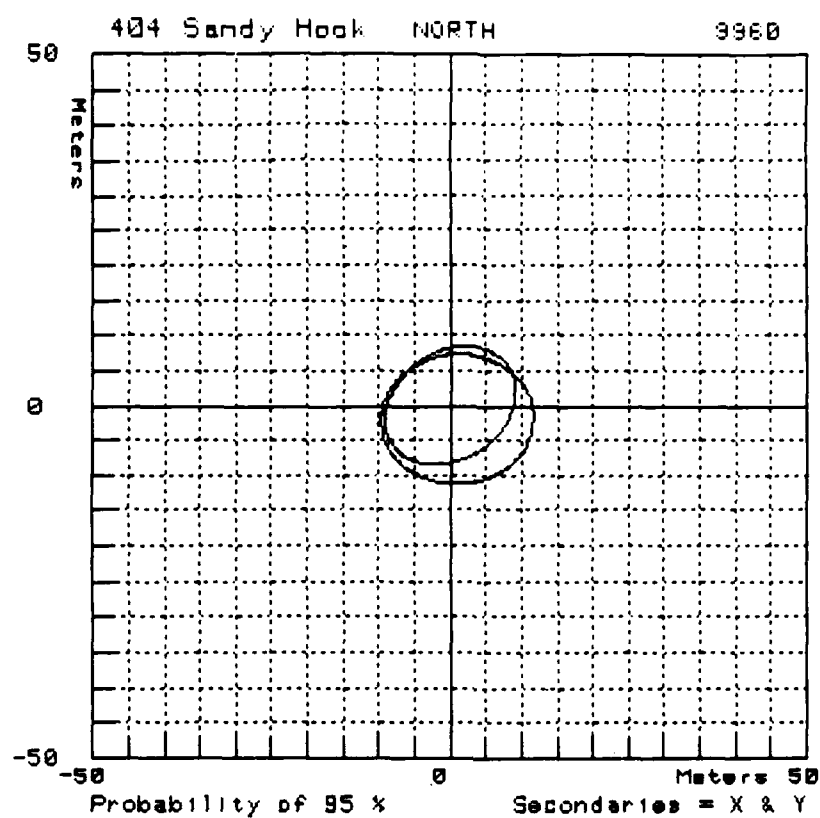
Positioning System
From G-NRN

W-LOP: 175.3 deg	Gradients: 806 ft/usec
X-LOP: 196.1 deg	Gradients: 578 ft/usec
Y-LOP: 262.4 deg	Gradients: 598 ft/usec









HMS SITE INFORMATION

AVERY POINT, GROTON, CT

Monitor: Type-D
Monitor Equipment: LC-404 and HP-9915
Data Collection: 12 May 1981 - Present

GRI: 9960 U.S. Northeast Chain

TDW: 14700.085
TDX: 26135.562
TDY: 43995.105
TDZ: 60135.914

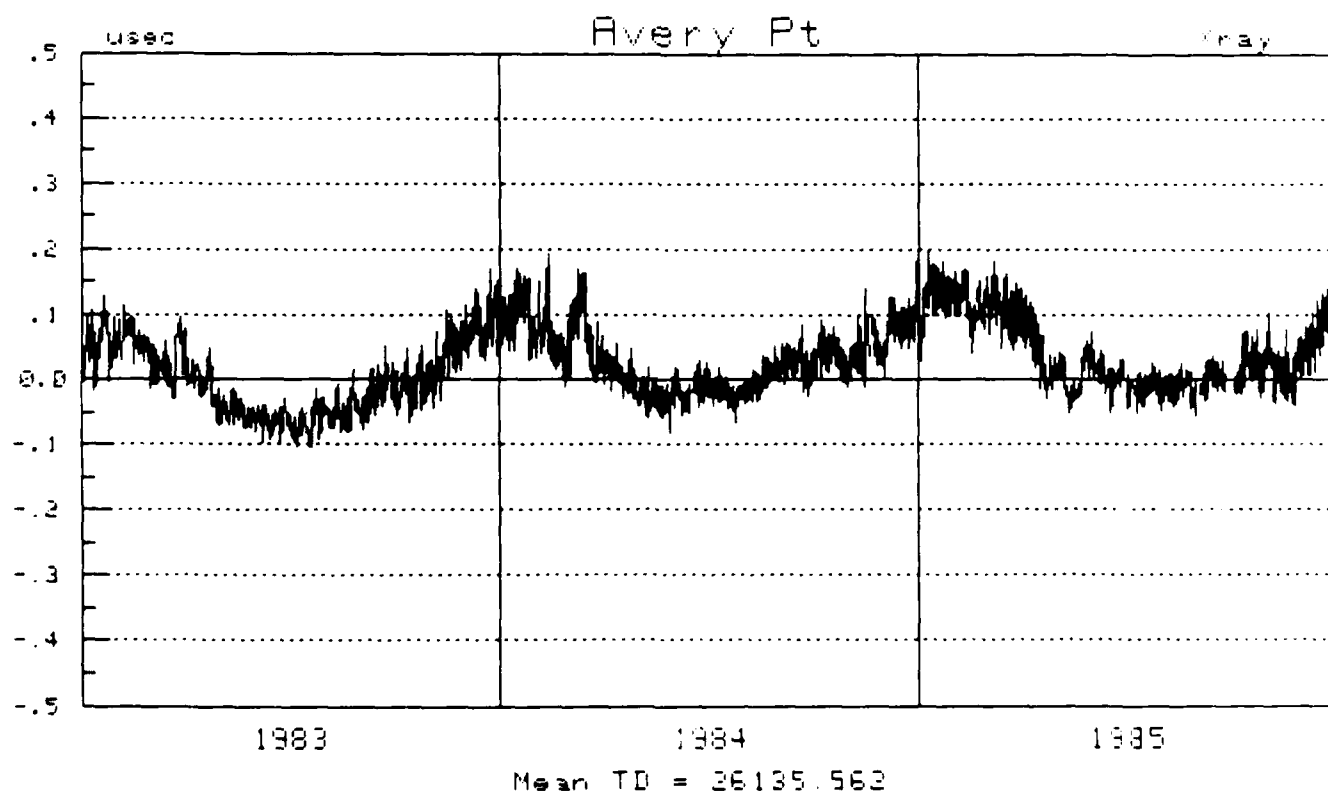
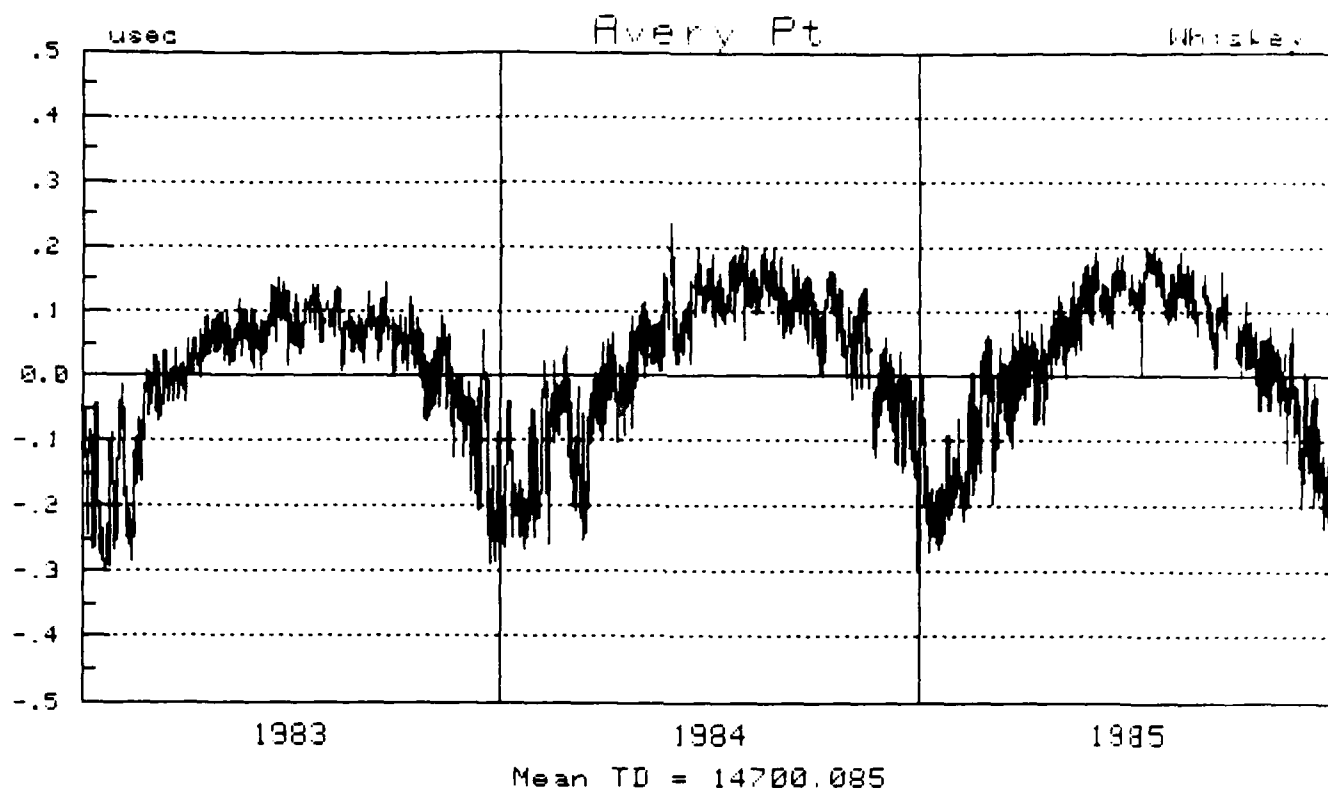
Receiving Antenna Location:

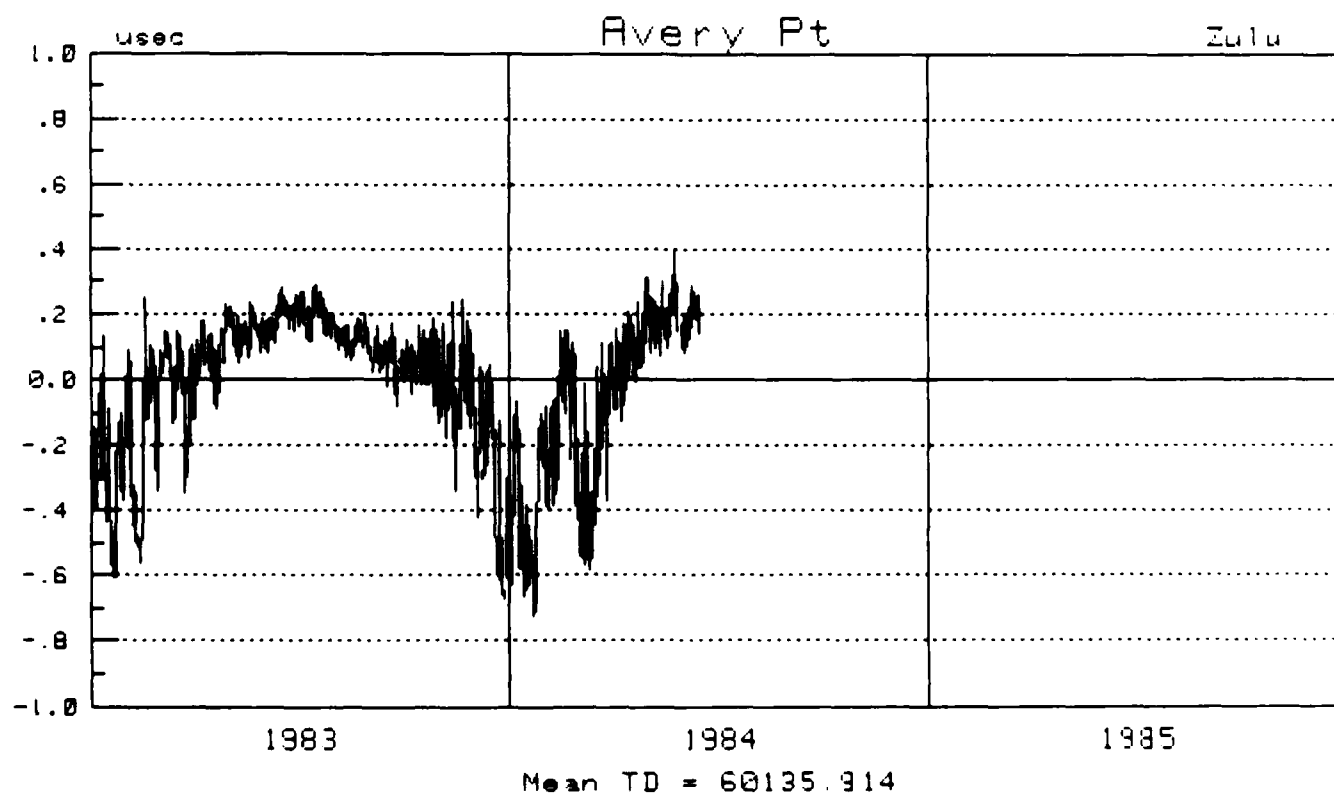
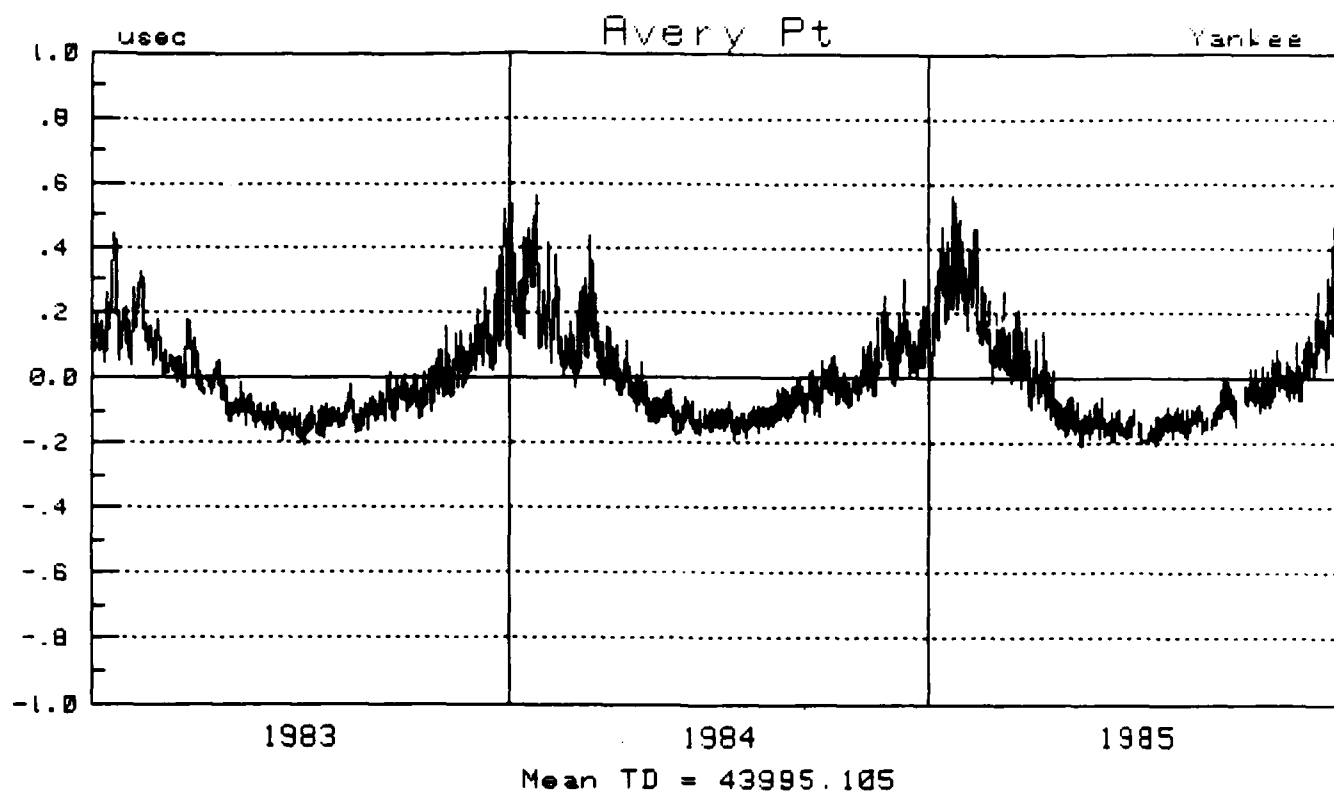
WGS 72
LAT : 41 18 59.85"N
LON : 72 03 49.74"W

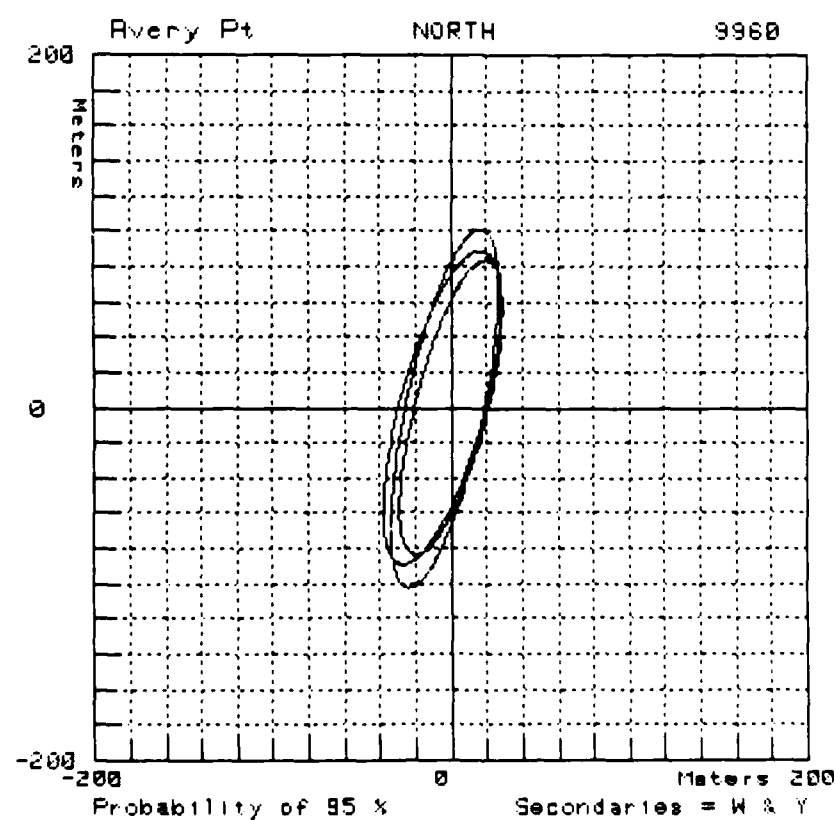
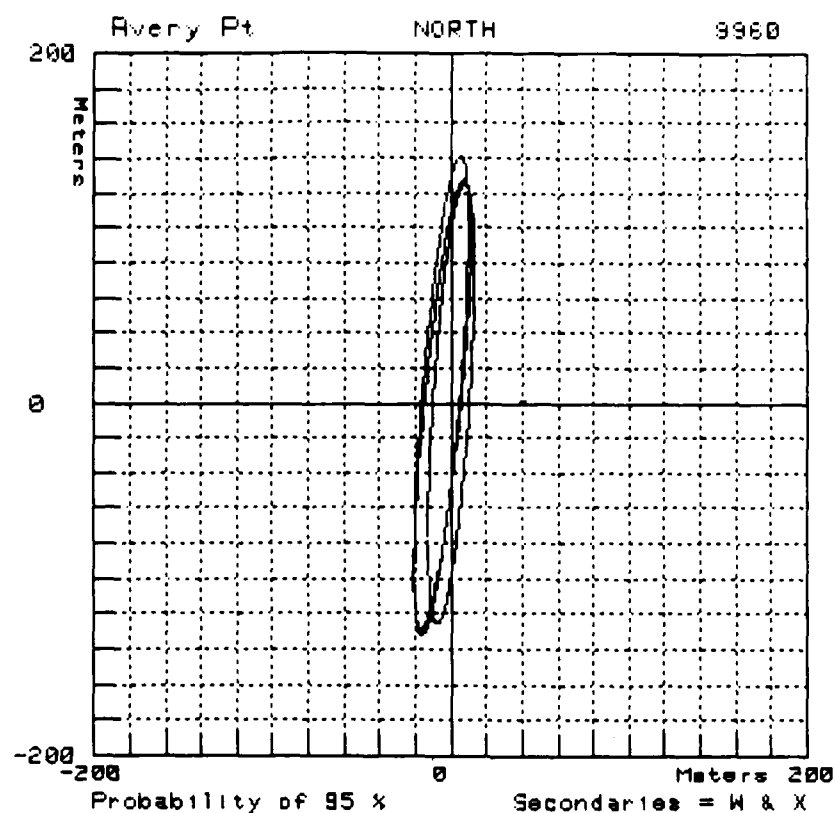
NAD 27
LAT : 41 18 59.88N
LON : 72 3 50.92W

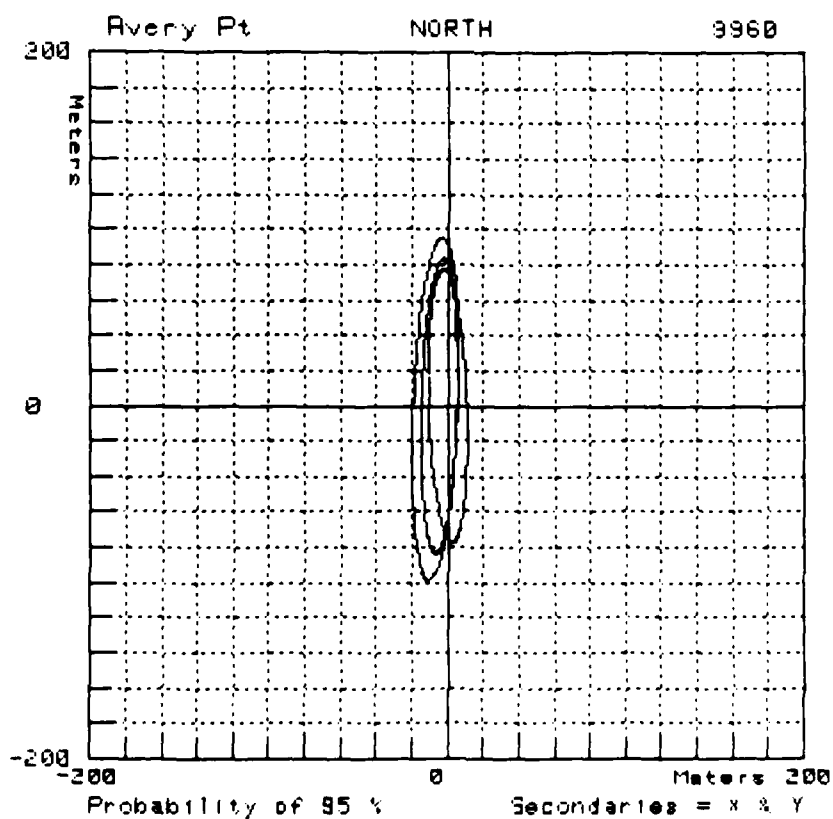
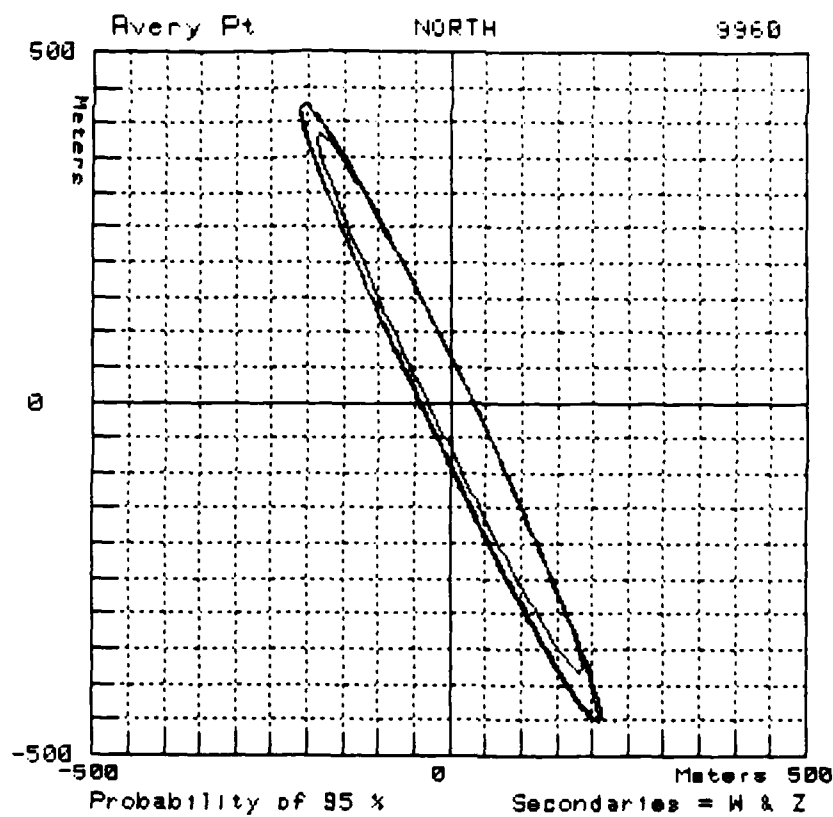
Positioning System
GPS

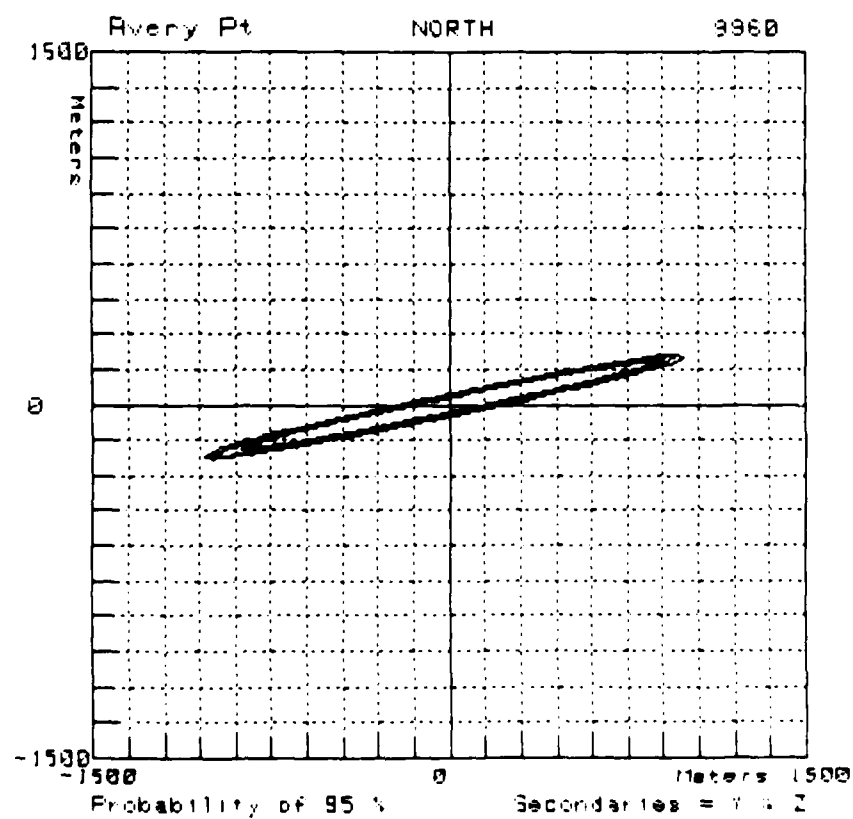
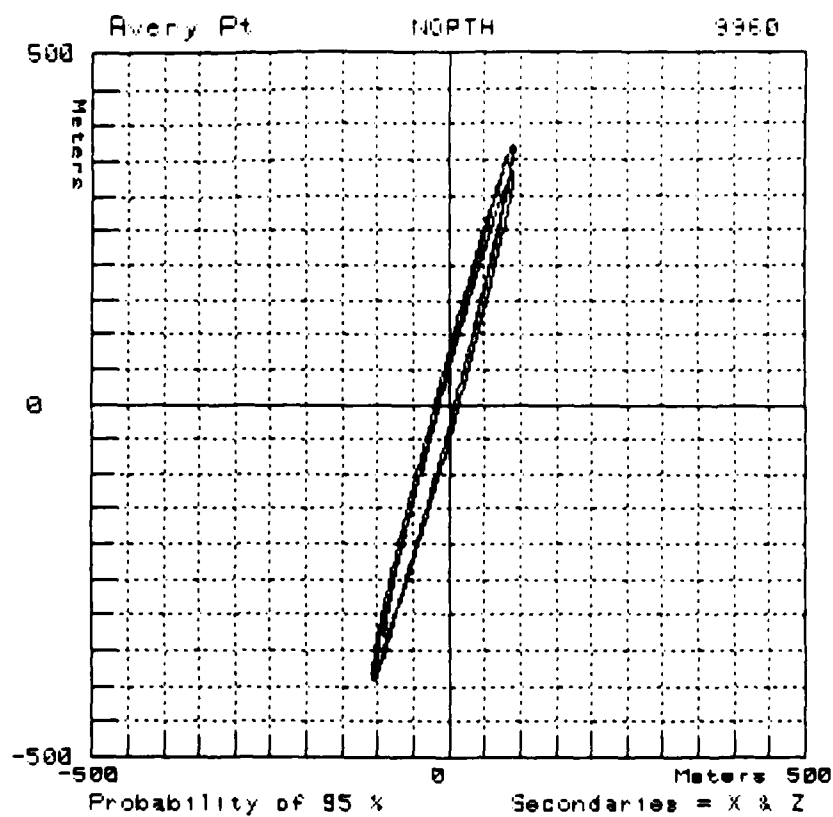
W-LOP: 160.1 deg	Gradients: 672 ft/usec
X-LOP: 192.4 deg	Gradients: 500 ft/usec
Y-LOP: 253.8 deg	Gradients: 776 ft/usec
Z-LOP: 280.5 deg	Gradients: 2263 ft/usec











HMS SITE INFORMATION

YORKTOWN, VIRGINIA

Monitor: Type-C
Monitor Equipment: LC-404 and PCM-12
Data Collection: 20 September 1981 - 12 August 1984

GRI: 9960 U.S. Northeast Chain

TDX: 27324.595
TDY: 41432.032
TDZ: 58472.150

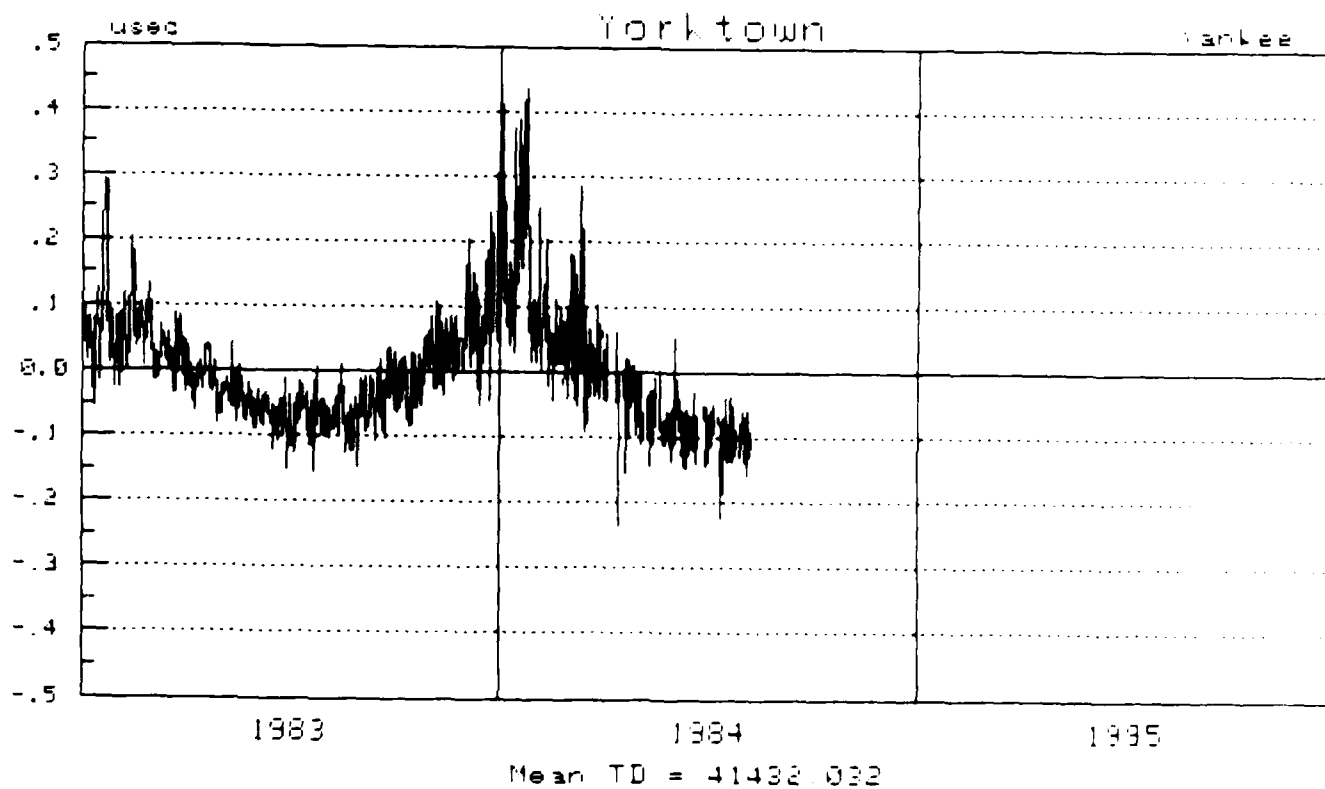
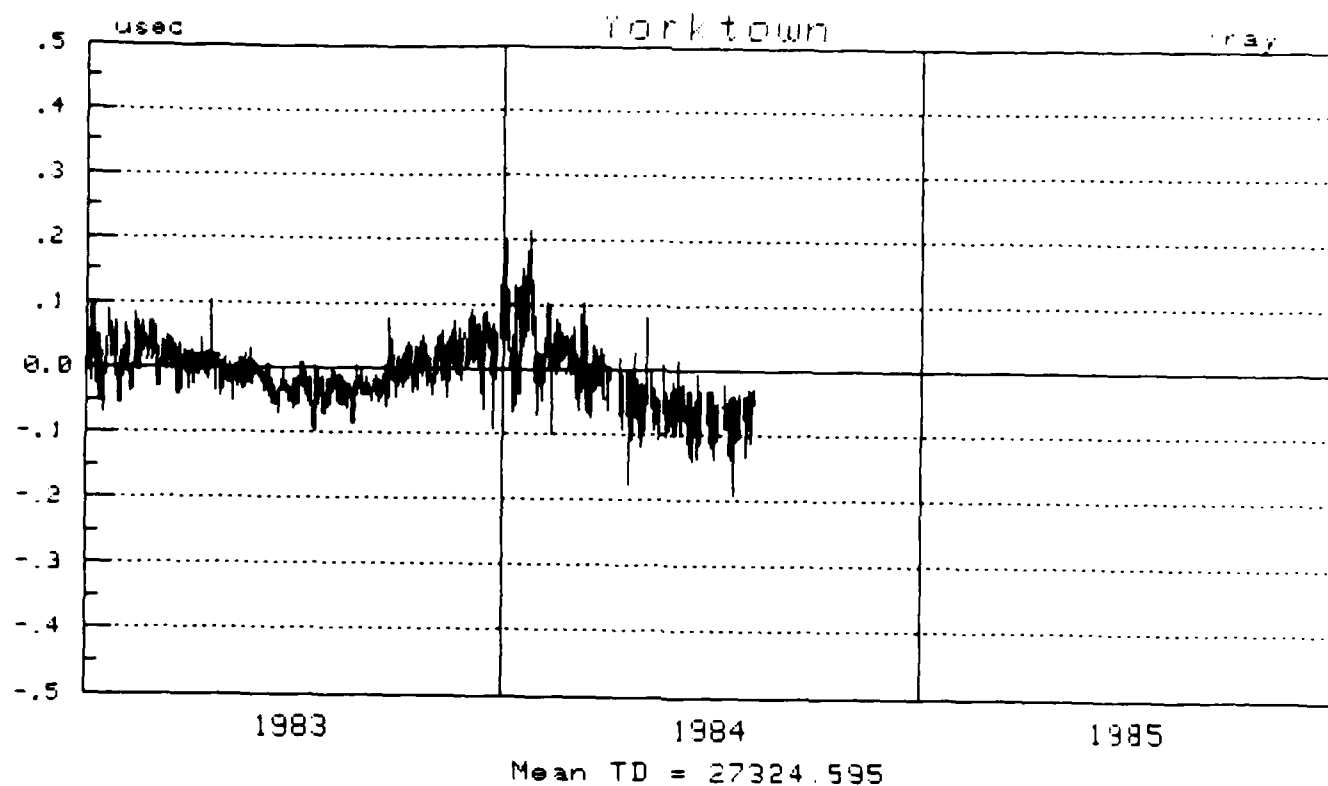
Receiving Antenna Location:

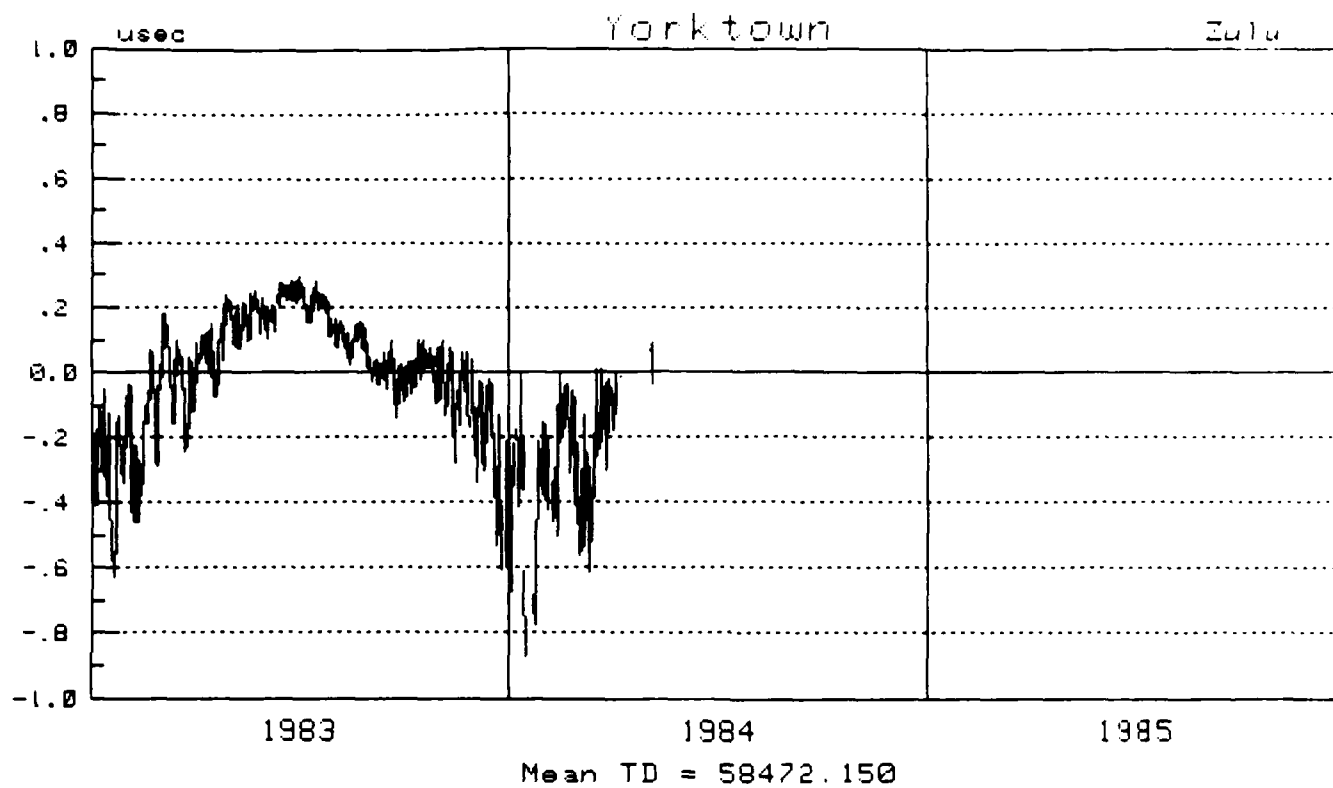
WGS 72
LAT : 37 13 29.02N
LON : 76 28 46.01W

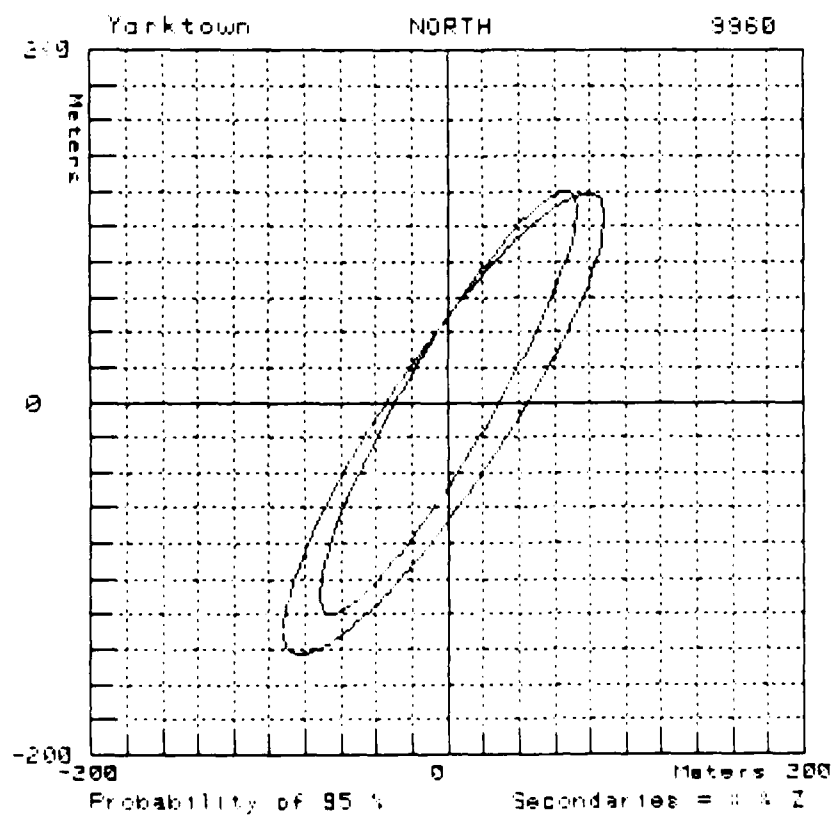
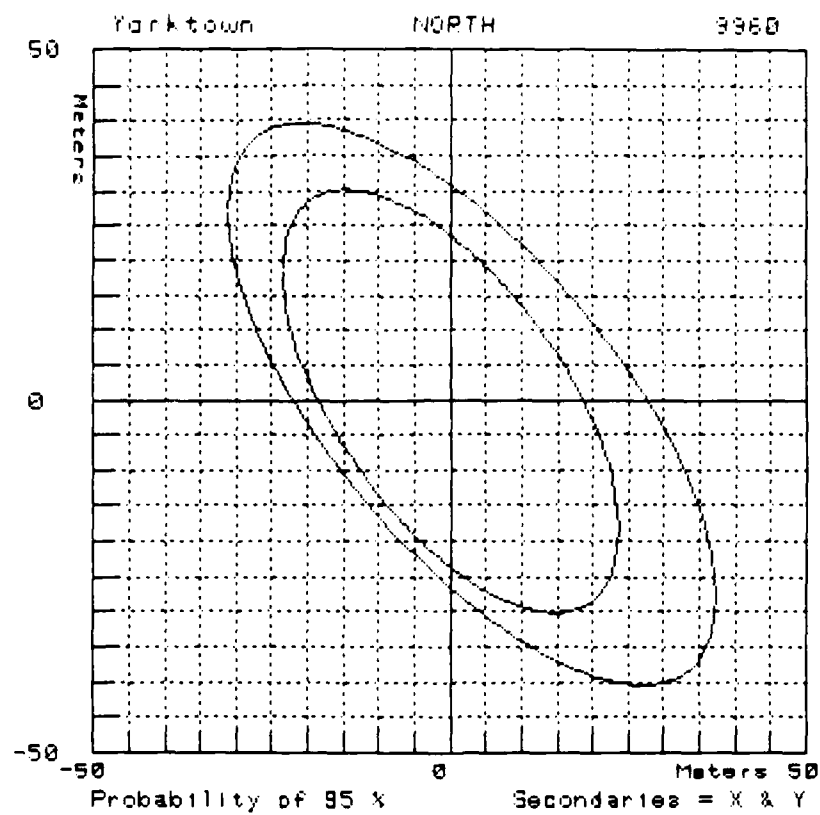
NAD 27
LAT : 37 13 28.81N
LON : 76 28 46.63W

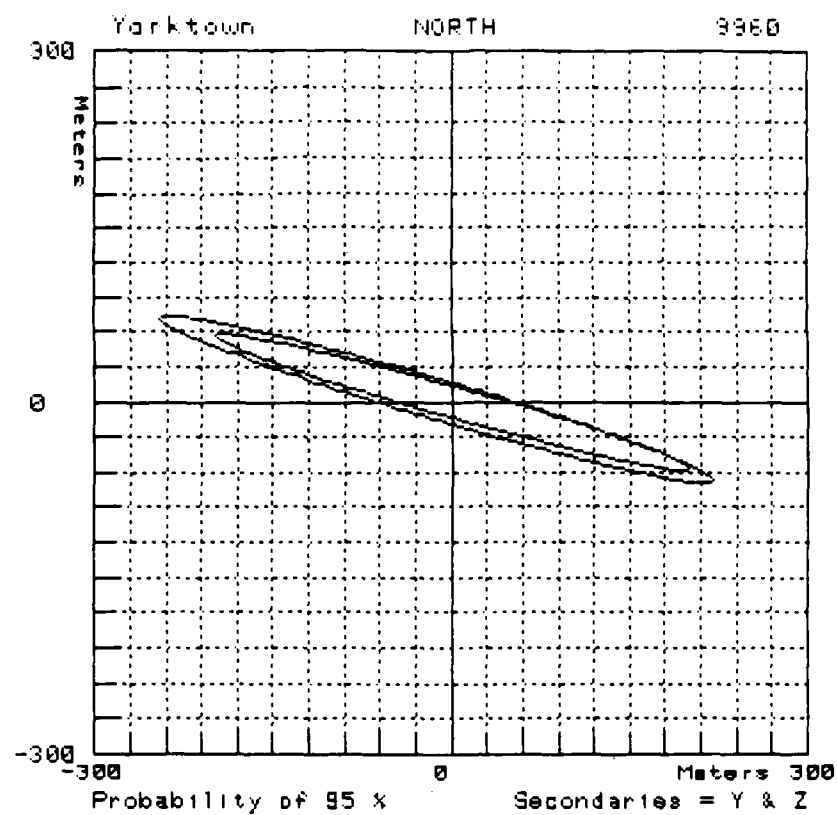
Positioning System
GPS

X-LOP: 203.0 deg	Gradients: 1116 ft/usec
Y-LOP: 279.1 deg	Gradients: 503 ft/usec
Z-LOP: 323.6 deg	Gradients: 894 ft/usec









END

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DTIC